REMEDIAL INVESTIGATION PROGRAM
FOR
AMCA INTERNATIONAL CORPORATION
Park Forest, IL

April 4, 1985

Prepared By:

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Project No. 4047RA

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INTRODUCTION

1.0 DESCRIPTION

The property currently occupied by Continental/Midland covers 85.4 acres at 21000 Western Avenue, Park Forest, Illinois, approximately 16 miles south of Chicago. Operations at the current Continental/Midland plant began for the first time in late 1946 or 1947 by which time two Quonset hunts and a maintenance building had been constructed. Prior to the erection of these buildings, no known manufacturing operations, or any other operations, are known to have occurred on the property. The best available information is that the entire area was farmland.

No manufacturing operation or activity is known to have been carried out in any area other than that bounded on the north and south by the fences on the current property, the east by Western Avenue, and to the rear by the dirt road just to the east of the concrete pad on which a Quonset hut (Q5) stood. There are only two slight exceptions: from 1950 until 1976 an Imhoff wastewater treatment plant was in operation to the rear (west) of the property, and there was a magnesium burn pile between the Imhoff plant and the plant proper.

The buildings at the Park Forest plant were constructed according to the schedule given in Appendix A. Recent work has included paving over part of the back lot where semi-trailer trucks turn and load, as well as erecting a metal building attachment to Building No. 7.

The basic manufacturing processes used at Park Forest were established by the Mall Tool Company in 1946 and have not varied since. Essentially, the products manufactured at the plant have required the cutting, grinding, degreasing, plating and painting of metal tools and products. A list of the goods manufactured, and the labels under which they were sold, appears in Appendix B. Under Mall Tool (1945-1956), Remington Arms (1956-1969), DESA Industries (1969-1975) and AMCA (1975-present), the products lines were all but identical, as can be seen in Appendix B. Recently, however, the Park Forest plant has been producing powder actuated tools almost exclusively.

A list of these manufacturing processes used at the Continental/Midland plant has been compiled based upon the records of the products manufactured and interviews with plant personnel. This list is contained in Appendix C. Because so many of the products produced under different owners involved using the same processes, no attempt is made to distinguish between those operations which continued or those which were discontinued briefly only to be started again. No plating is currently done on the premises. According to the best recollection of manufacturing, maintenance, and other personnel, Appendix C includes all processes carried out at Park Forest from 1946 to the present. Several of the interviewed personnel have been employed at the plant for over 30 years.

1.1 Study Objectives

The primary objectives of the Remedial Investigation of the Park Forest property are to: 1) identify materials and wastes which may remain on the property, 2) physically and chemically characterize any of those materials which could potentially be released to the soil or ground water system, 3) estimate the approximate quantities of materials which may have been released, 4) evaluate any types and quantities of materials which may migrate from the property, 5) assess the possible effects of any such migration on potential receptors, and 6) provide adequate data to support any risk evaluation or feasibility study which may be needed.

To meet these objectives, four plans have been formulated: 1) a Remedial Investigation Work Plan; 2) a Project Sampling Plan; 3) a Project Safety Plan; and, 4) a Quality Assurance Plan. These are included as Sections 2, 3, 4 and 5 respectively, to this document. An overview of each plan follows.

1.1.1 Remedial Investigation Work Plan

The Remedial Investigation Work Plan describes the approach and procedures necessary to perform a risk-based remedial investigation at the Park Forest property. The nine primary components of the investigation are discussed: 1) plan development; 2) mobilization; 3) three dimensional characterization; 4) ground water monitoring well installation; 5) water quality sampling of water production wells; 6) data analysis and interpretation; and, 7) preparation of a Remedial Investigation Report.

1.1.2 Project Sampling Plan

The Project Sampling Plan briefly presents the history of operations at the plant, reviews previous agency investigations and analyses, and addresses work activities required to meet the objectives of the Remedial Investigation Work Plan. Anticipated activities covered in detail include: 1) surface geophysical surveys; 2) surficial soil back-hoe test pit investigations; 3) the subsurface boring program; 4) analytical requirements for soil and ground water samples; 5) surface soil sampling; 6) ground water sampling; 7) surface water sampling, 8) analytical requirements for various samples; 9) decontamination procedures; and, 10) documentation and reporting.

1.1.3 Project Safety Plan

Topics addressed by the Project Safety Plan are: 1) the duties of safety personnel; 2) emergency services and contacts; 3) the nature of potential hazards; 4) work schedules; 5) entry restrictions; 6) facilities; 7) environmental monitoring and equipment; 8) required protective equipment, including the level of protection; and 9) decontamination procedures for personnel, equipment, and by-products.

1.1.4 Quality Assurance Plan

The Quality Assurance Plan presents the policies, organization, objectives, functional activities, and specific quality assurance/quality control activities designed to achieve the data quality goals of the project.

The following are discussed in the Quality Assurance Plan: 1) project scope; 2) project sampling program; 3) analytical procedures; 4) project organization and responsibilities; 5) data quality requirements and assessments; 6) sample custody procedures; 7) calibration procedures and preventative maintenance; 8) documentation, data validation, and reporting; 9) performance and systems audits; and, 10) quality assurance reports.

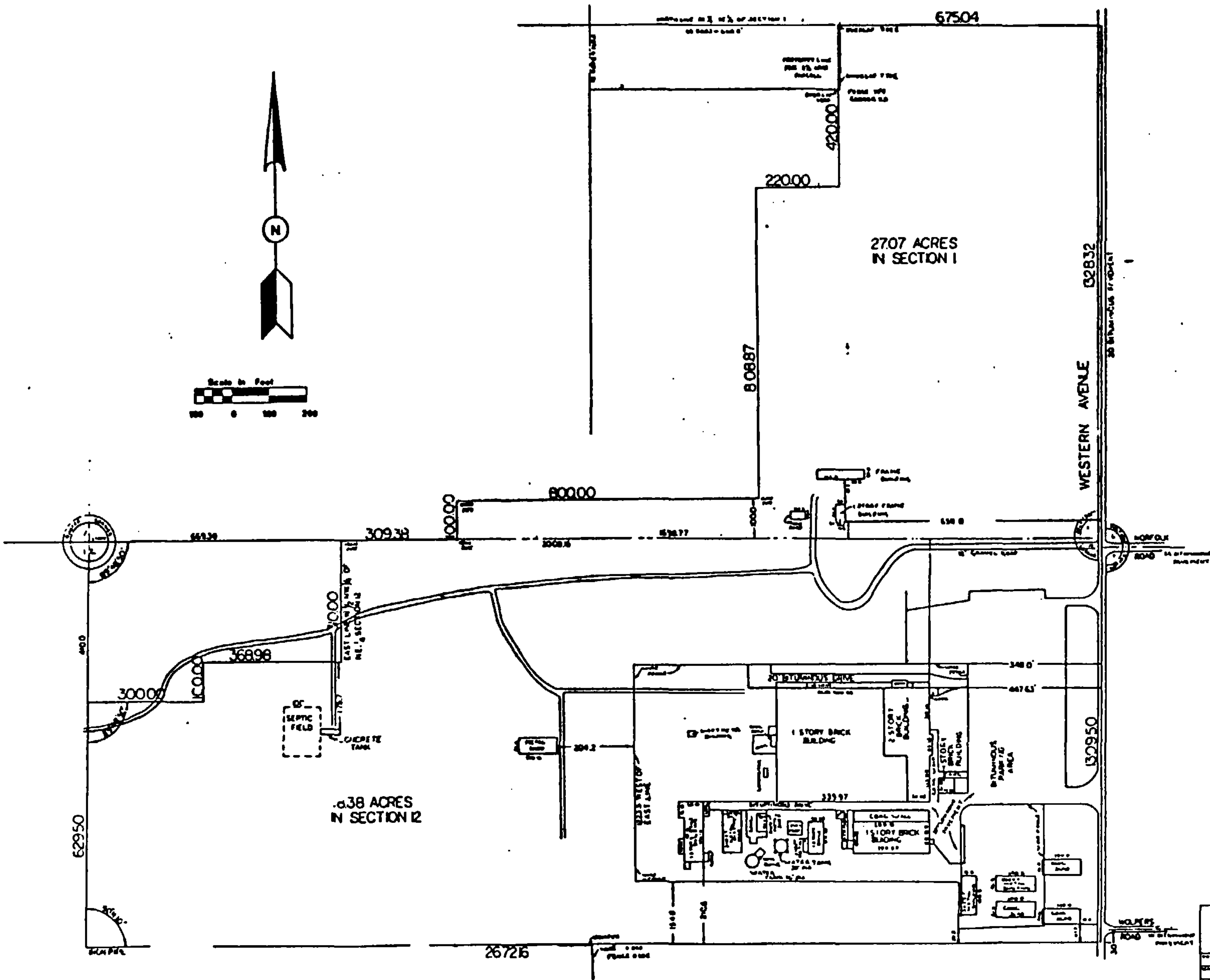
SECTION 2
WORK PLAN

2.0 INTRODUCTION

This Remedial Investigation Work Plan describes the proposed approach and procedures to perform a Remedial Investigation at the property owned by DESA Industries, Inc., and operated currently by Continental/Midland. The property is located at 25000 South Western Avenue, Park Forest, Illinois (Figure 2-1). The goals of the Remedial Investigation are (1) to identify and characterize the source and distribution of chemicals and chemical constituents at, or emanating from, the property, and (2) to gather sufficient data and information as a first step to determine the necessity for, and extent of, remedial action at the property. Such remedial action as may prove necessary will be done in accordance with Section 300.69 (f) of the National Contingency Plan, 47 Federal Register, page 31217 (July 16, 1982).

This work plan is designed to be a Remedial Investigation adequate to conduct a Feasibility Study through conceptual design and to provide data to characterize any sources, evaluate pathways, and to monitor the potential receptors of materials on the property. The data collected in the Remedial Investigation should be adequate to conduct a Risk Assessment analysis.

The Illinois Environmental Protection Agency (IEPA) and the United States Environmental Protection Agency (USEPA)



PLAN VIEW

FIGURE 2-1

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[collectively called "the agencies"] will have access to data generated by the study, and meetings will be held on an as needed basis between representatives of AMCA International Corporation, the parent corporation of DESA and Continental/Midland and the agencies to facilitate the transfer of data. The investigation will be funded by DESA.

The principle components of the investigation are as follows:

(1) Plan Development
(2) Project Mobilization
(3) Project Characterization
(4) Surface Soil Evaluation
(5) Ground Water Monitor Well Installation
(6) Well Sampling Procedures and Ground Water Monitoring
(7) Surface Water Monitoring
(8) Data Analysis and Interpretation
(9) Remedial Investigation Report

The methodologies for each of the principle components of the investigation are presented in subsequent sections of this work plan.

2.1 Plan Development

Sampling, safety, and quality assurance plan will be prepared prior to the initiation of field work. Descriptions of the plans are provided below:

2.1.1 Project Sampling Plan

A Project Sampling Plan will be prepared in accordance with the Remedial Investigation Work Plan. The Project Sampling Plan will outline the objectives of the field investigation, designate sample locations, numbers, sampling methodology and quality assurance requirements for field instrumentation, identify sample compositing, splitting, preservation, handling, shipment, documentation procedures, and will identify key project personnel. All samples obtained during the investigation will be sent to Rocky Mountain Analytical Laboratory, Arvada, Colorado, for analysis of the parameters identified in the Sampling Plan.

Should any other party have tests or analyses performed which are additional to those identified in the Project Sampling Plan, the costs of such additional tests or analyses shall be borne by that party.

It is anticipated that sampling will initially consist of an overall evaluation (Phase I) based on intensive shallow soil borings, backhoe pits, soil sampling, production well sampling, surface water sampling, and stream sediment sampling. None of the soil borings or pits will extend to a depth of greater than 15 feet. Additionally, non-fuel underground tanks and associated piping will be checked for leakage through a leakage test that detects leaks as small as .05 gallons per hour, and conforms with the standards of NFPA 329-1983. Those tests will be performed by an experienced tank testing contractor.

If shallow soil samples indicate significant amounts of hazardous constituent migration, and a high potential for ground water contamination, the evaluation will enter Phase II. Phase II will consist of soil borings and ground water monitor well installations to a depth of greater than 15 feet. These borings and well installations will provide additional information on stratigraphy, ground water quality, and chemical transport pathways and extent.

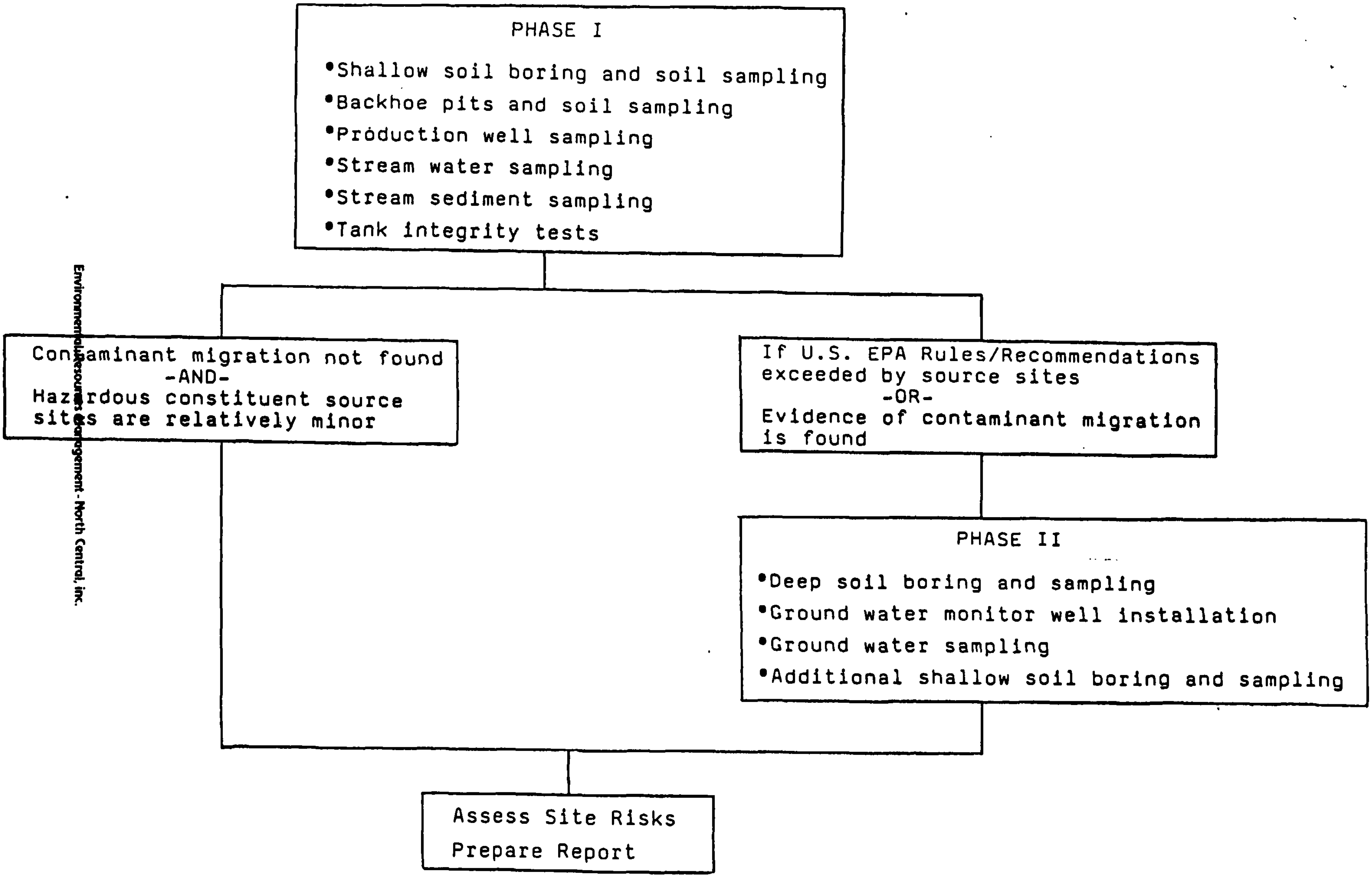
The flow chart shown in Figure 2-2 graphically presents the study methodology.

Designated soil and water samples will be analyzed for pH, priority pollutant volatiles, polychlorinated biphenyls (PCB's) and heavy metals in the laboratory. All water quality samples collected will be field analyzed for pH, temperature, and specific conductance.

2.1.2 Project Safety Plan

A Project Safety Plan will be prepared for use by project personnel and subcontractors. The Project Safety Plan will include required levels of protective apparel, an assessment of respiratory and physical hazards, required safety equipment, safety requirements peculiar to the property, emergency procedures, addresses or phone numbers of local emergency services (hospital, ambulance, fire, police, poison center), and guidelines for a personnel training program. A Project Safety Officer will be assigned to the project.

FIGURE 2-2
FLOW CHART



2.1.3 Quality Assurance Plan

A Quality Assurance Plan will be developed for the investigation. The Quality Assurance Plan will present the policies, organization, objectives, functional activities, and specific activities designed to achieve the data quality goals of the project. The Quality Assurance Plan will include: a project description; project organization and responsibility; objectives for data measurement in terms of precision, accuracy and completeness; sampling procedures; sample custody; calibration procedures and frequency; analytical procedures; data reduction; data validation and reporting; and internal quality control checks and their frequency.

2.2 Project Mobilization

Before subsurface investigations start, the location of buried utilities which may interfere with subsurface exploration will be determined.

Prior to, and during the work, an ambient air monitoring program using various air sensors will be established to: (1) develop the level of existing volatile organic emissions, as indicated by the sensors; (2) determine if any changes to the baseline occurs during field work, and (3) determine if any changes from the baseline can be detected at specific borehole locations or areas of suspected contamination.

2.3 Project Characterization

The purpose of the project characterization component of the investigation is to obtain additional data regarding the quantity and characteristics of any materials which may have been disposed on the property as a result of past operations. The field investigation will be divided into three components; a data survey, a boring and excavation program, and surface and ground water quality sampling programs.

It is understood that different companies have owned the Park Forest manufacturing facilities and that a number of manufacturing operations have been carried out on the property. These past operations may have included disposal of a portion, or all of the wastes at various locations on the property.

2.3.1 Data Survey

Long-term employees at the plant will be interviewed and additional data collected regarding past practices and operations conducted at the plant. Historical aerial photographs of the property will be studied to identify potential areas of contamination or environmental concern. Information will be requested on observations of disposal practices and other indications of material release or disposal.

Data on the local hydrogeology will be collected from the state geological and water surveys, the United States Geological Survey, the Soil Conservation Service, the United States Geological Survey, local drillers, and any nearby U.S. EPA Superfund reports.

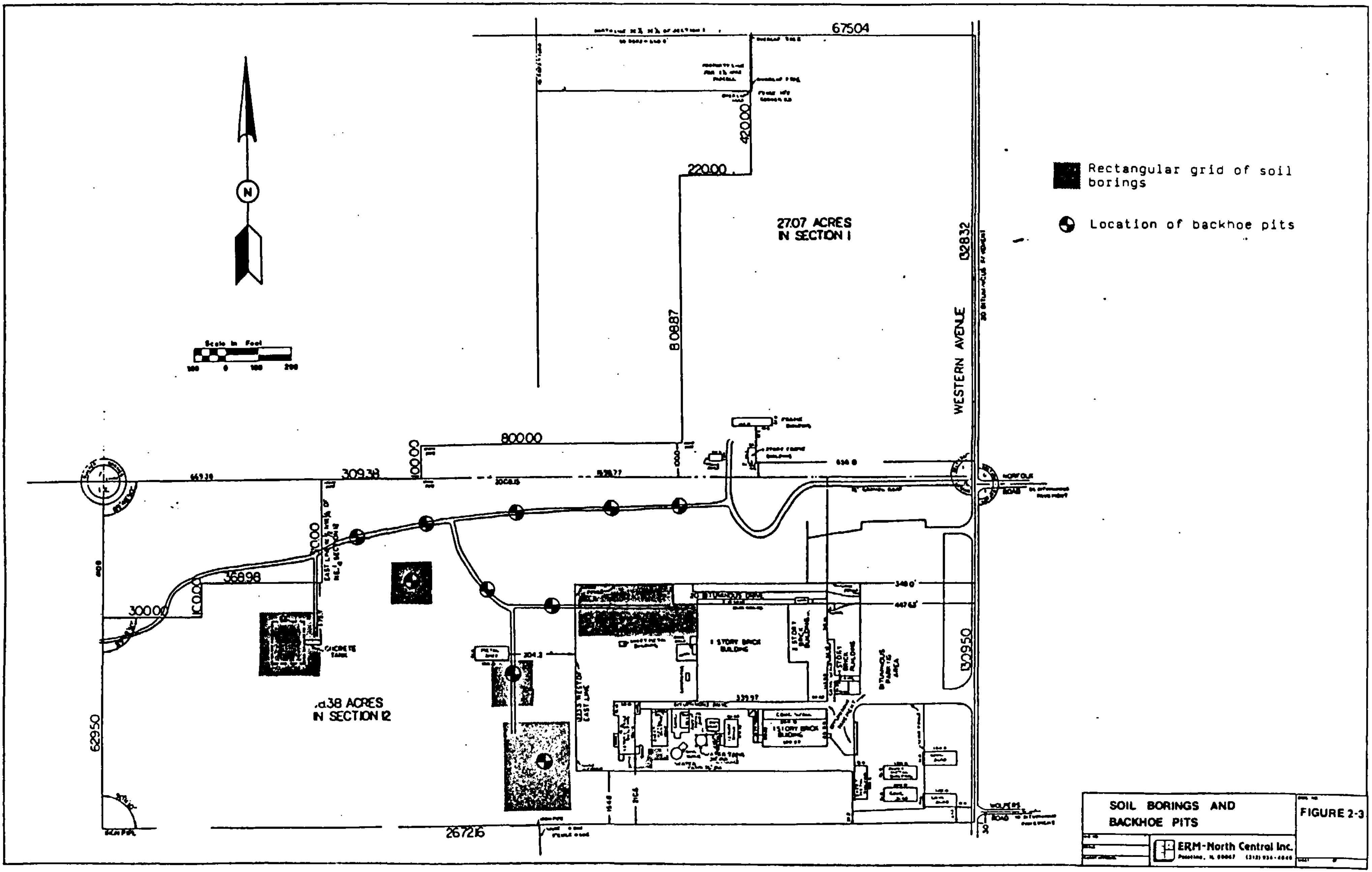
2.3.2 Subsurface Investigation (Phase I)

The purpose of the Phase I subsurface investigation is to identify the characteristics of the local soils determine areas that may have been used or subject to disposal operations, collect soil and ground water samples for laboratory analysis, and determine the potential routes of contaminant movement.

The subsurface investigation will consist of hand auger borings and backhoe pits. Hand auger borings will penetrate to a maximum depth of four feet, whereas backhoe pits may penetrate to a maximum depth of fifteen feet or to the shallow water table. This boring program will provide information regarding the horizonation, thickness, continuity and distribution of the unsaturated surface soils and any possible contamination over the property.

Currently, it is anticipated that soil borings and backhoe pits will be as located on Figure 2-3. The subsurface investigation may be expanded or reduced based on review of past practices, aerial photographs, and the development of investigative activities.

Any fluids and solids which are generated during the investigation will be redeposited at the point of generation. If subsequent analytical results indicate that these materials would be classified as a hazardous waste, all such materials generated after that time would be disposed of at an approved facility.



SOIL BORINGS AND BACKHOE PITS

FIGURE 2-3

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2.3.2.1 Shallow Boring Program

Shallow borings will be located based on data obtained from aerial photographs and employee interviews. The borings will be located so as to identify possible pathways and rates of potential contaminant migration in the soil. Borings will be located to maximize the possibility of finding non-native materials or migration pathways. The data obtained from the initial subsurface investigation will be carefully reviewed and will provide, along with the geophysical surveys, the basis for locating additional shallow borings, deep borings, and ground water monitoring wells, as appropriate.

Field soil samples collected for physical and chemical analysis will be labeled, sealed, and placed on ice until analyzed. All samples will be maintained under chain-of-custody protocol through shipment to the analytical laboratory, within one week of collection, for analysis of the parameters listed in Table 2.1. Samples will be considered "unanalyzed samples of hazardous wastes from other than closed containers" for shipping purposes. All applicable DOT shipping regulations will be strictly adhered to.

2.3.2.2 Backhoe Pit Program

Backhoe pits will be located based on data obtained from aerial photographs and employee interviews. The backhoe pits will be located to allow visual inspection of soil profiles over an area as well as to allow the collection of soil samples from very specific locations within the soil profile. The pits will also permit a determination of the

TABLE 2.1

SOIL SAMPLE
PHYSICAL/CHEMICAL PARAMETERS

Physical	Chemical
Unified Soil Classification	Volatile Organic Compounds
Permeability	Polychlorinated Biphenyls
	Cyanide
	Arsenic
	Barium
	Cadmium
	Chromium
	Copper
	Lead
	Magnesium
	Mercury
	Molybdenum
	Nickel
	Selenium
	Zinc

depth and extent of the source size of any potential contaminants which might be found.

Field soil samples collected from backhoe pits for physical and chemical analysis will be labeled, sealed, and placed on ice until analyzed. All samples will be maintained under chain-of-custody protocol through shipment to the analytical laboratory, within one week of collection, for analysis of the parameters listed in Table 2.1. Samples will be considered "unanalyzed samples of hazardous wastes from other than closed containers" for shipping purposes. All applicable DOT shipping regulations will be strictly adhered to.

2.4 Ground Water Monitor Well Installation (Phase II)

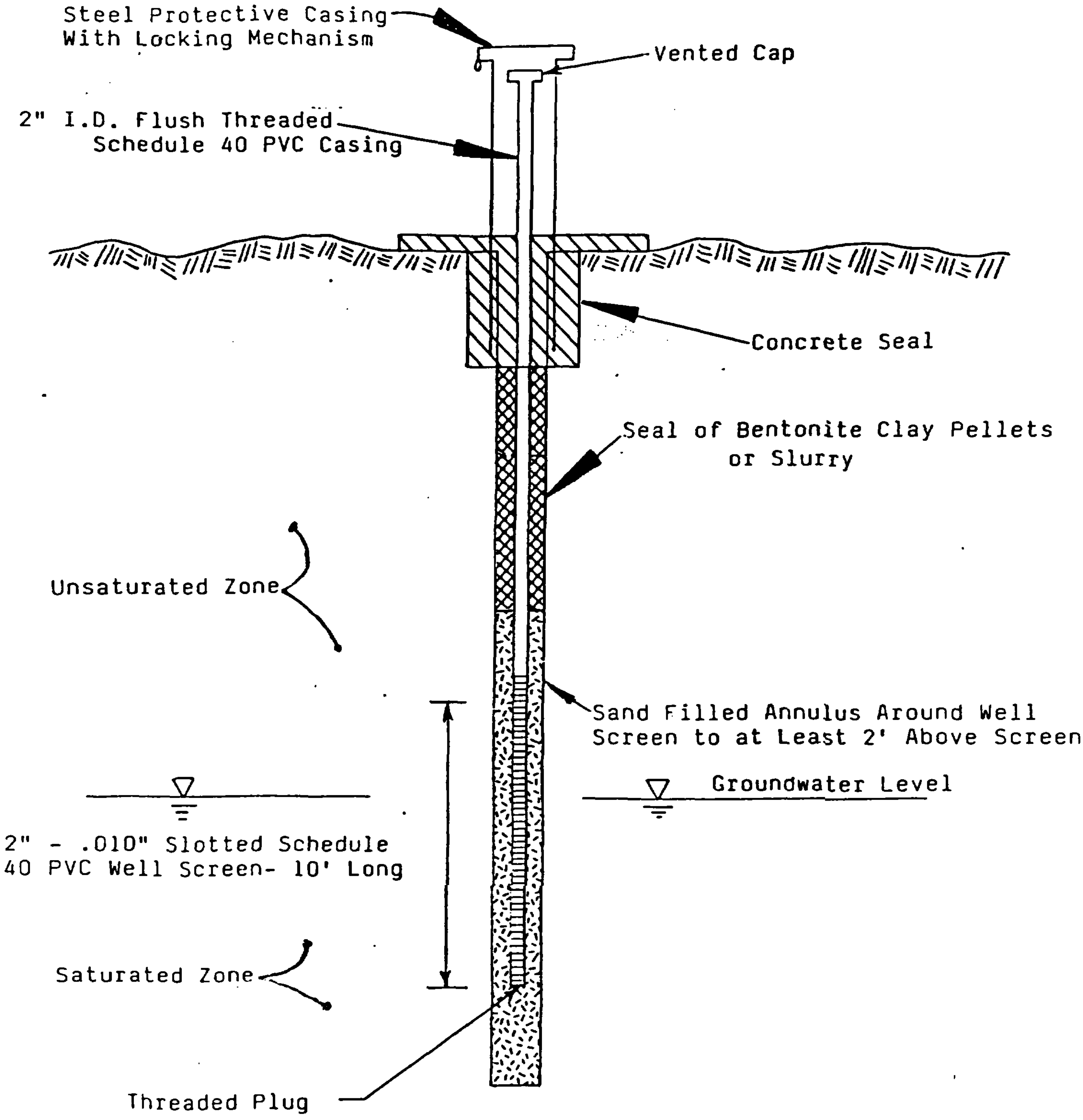
Ground water monitor wells will be installed only if the shallow soil investigation program indicates that a ground water contamination potential exists. The purpose of the wells will be to obtain additional information about the local stratigraphy and to obtain representative ground water samples to characterize chemical transport pathways and extent.

At least one well will be located upgradient of the property if it is determined that ground water flows predominantly in one direction throughout the property. The data from this well will be used to determine background ground water quality and serve as the basis for statistical analysis of changes that may have occurred in ground water quality downgradient from the property.

Deep borings for the installation of ground water monitoring wells will be conducted using hollow stem augers. Continuous split spoon samples will be collected in each boring to termination with all blow counts recorded. All borings will be logged by a qualified geologist and preserved for chemical or physical analysis in the appropriate sample containers. All field measurements and observations will be recorded in a field logbook by a registered geologist. The wells will be installed in the uppermost continuous water bearing layer beneath the property.

Intermittent soil samples for chemical or physical analysis will be obtained from the continuous soil sampling. Soil samples will be obtained using a split-barrel sampler with a catching mechanism. The soil samples will be logged in the field and placed in sample containers. It is expected that one or two soil samples from each of the well installation will be analyzed for a variety of physical and chemical parameters.

The monitoring wells will be completed according to the well detail provided in Figure 2-4. The wells will be completed by inserting 10 feet of .010 inch slotted Schedule 40 2-inch inner diameter well screen connected by threaded flush joints to Schedule 40 2-inch inner diameter casing extending at least 1 foot above the ground surface. The well screen will extend to at least two feet above the water table. An appropriately sized sand pack will be placed around the screen and extend a minimum of one foot above the top of the screen. The annular space above the sand pack will be sealed with either a bentonite slurry or bentonite pellets. A surface seal of neat cement will extend three feet below



NOTE: Not to scale.

TYPICAL WELL INSTALLATION	DWG. NO. FIGURE 2-4
W.O. NO / SCALE / CLIENT APPROVAL	ERM-North Central inc. Palatine, IL 60067 (312) 934-4646
	SHEET OF

the ground surface into which the protective steel casing will be inserted. Each well will be developed upon completion to remove any drilling fluids or fines from the screened area.

2.5 Well Sampling and Ground Water Monitoring

Ground water samples will be obtained from existing water production wells, or from any ground water monitoring wells installed during the study.

In order to remove potentially unrepresentative ground water samples, each well will also be flushed by pumping or bailing prior to sampling. Temperature and specific conductance will be monitored in each well during evacuation. When these parameters stabilize (less than 5% difference between successive readings), sampling will commence. If the wells do not produce adequate quantities of water, then a minimum of three well volumes will be evacuated prior to sampling. Water level measurements in each well will be recorded prior to sampling and evacuation. Ground water samples will be collected from each well using a bailer or peristaltic pump. Ground water monitoring and potable water supply wells will be analyzed in the field for temperature, pH and conductivity. Samples will subsequently analyzed for the parameters listed in Table 2-2.

2.5.1 Analytical Requirements

Samples from existing water production wells and from ground water monitor wells installed in this study will be analyzed

TABLE 2.2

GROUND/SURFACE WATER SAMPLE PARAMETERS

Field	Laboratory
Temperature	Volatile Organic Compounds
pH	Polychlorinated Biphenyls
Specific Conductivity	Cyanide
	Arsenic
	Barium
	Cadmium
	Chromium
	Copper
	Lead
	Magnesium
	Mercury
	Molybdenum
	Nickel
	Selenium
	Zinc

for priority pollutant volatiles, PCB's, and heavy metals using EPA approved methods.

2.5.2 Analytical Quality Assurance

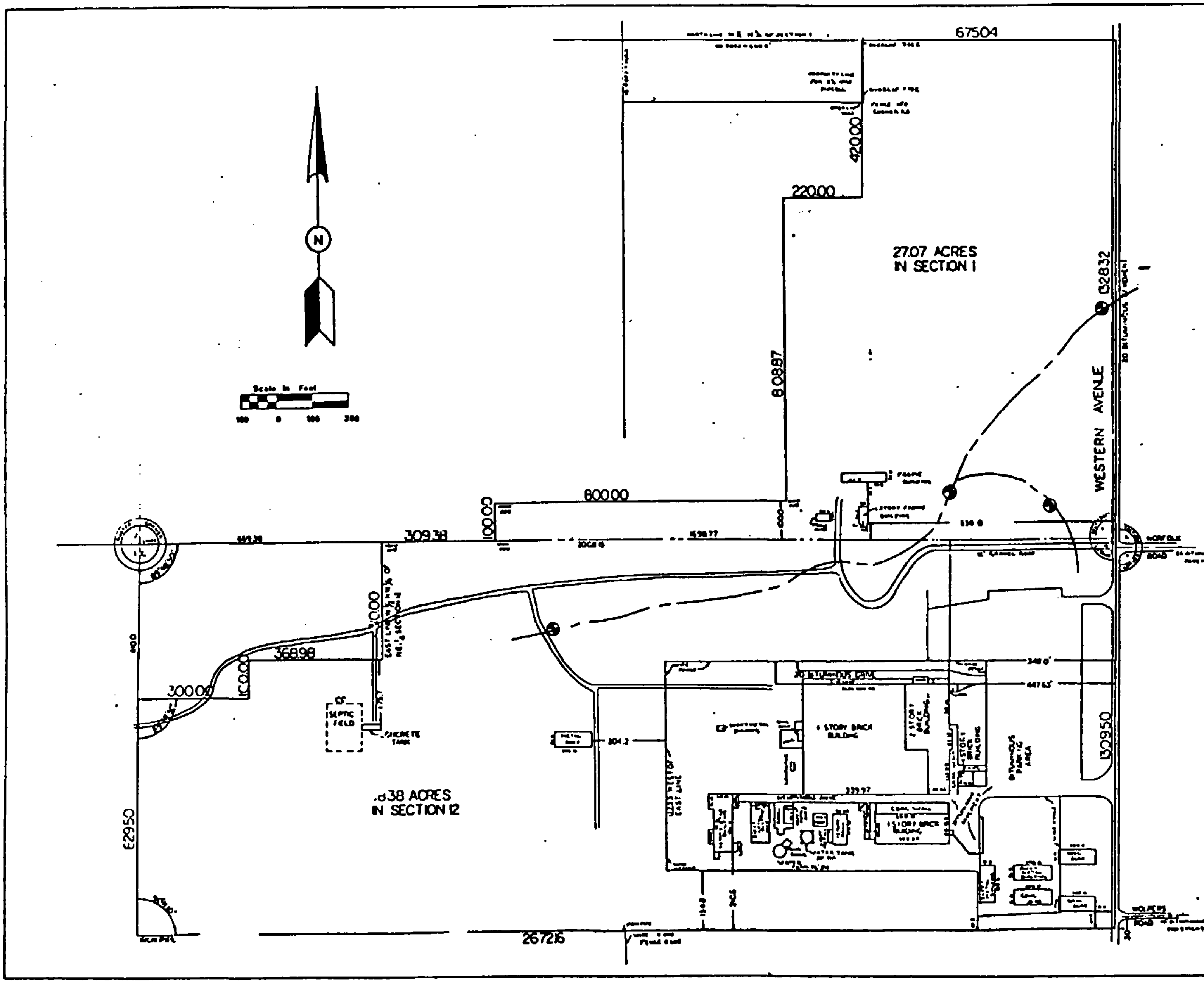
To monitor analytical laboratory performance, blank and duplicate samples will be submitted with samples collected in the field. All of the quality assurance samples will be prepared in the field and issued a sample number. The laboratory will not be notified in advance of the exact nature of the quality assurance samples.

Blank samples will be distilled water. One quality assurance sample will be submitted for approximately every ten soil or ground water samples.

2.6 Surface Water Monitoring

Surface water samples will be collected from locations indicated on Figure 2-5 as a means of assessing the surface water transport of contaminants from the property. Stream sediment samples will also be obtained from each point where surface water samples are obtained.

Surface water and sediment samples will be collected following EPA procedures. Field samples will be placed on ice until analyzed and will follow chain-of-custody protocol.



SURFACE WATER AND SEDIMENT SAMPLING

FIGURE 2-5

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2.7 Data Analysis/Interpretation

The data obtained during the remedial investigation will be compiled and evaluated following the field investigation and will be provided to the agencies on request.

The primary purpose of the data analysis and review task will be to characterize the property, evaluate the distribution of possible contaminants, and determine the ground and surface water transport pathways for migration.

2.8 Project Characterization

Information from the data surveys and field boring programs will be reduced, compiled, and reviewed. The inter-relationship of surface water to ground water and the recharge/discharge characteristics of the shallow and deep ground water flow systems will be assessed in the project characterization study. These data will be used to assess and evaluate the quantity and chemical characteristics of materials remaining or released on the property. This information, and data from the water quality monitoring program, will be used as the basis for the risk assessment studies.

2.9 Remedial Investigation Report

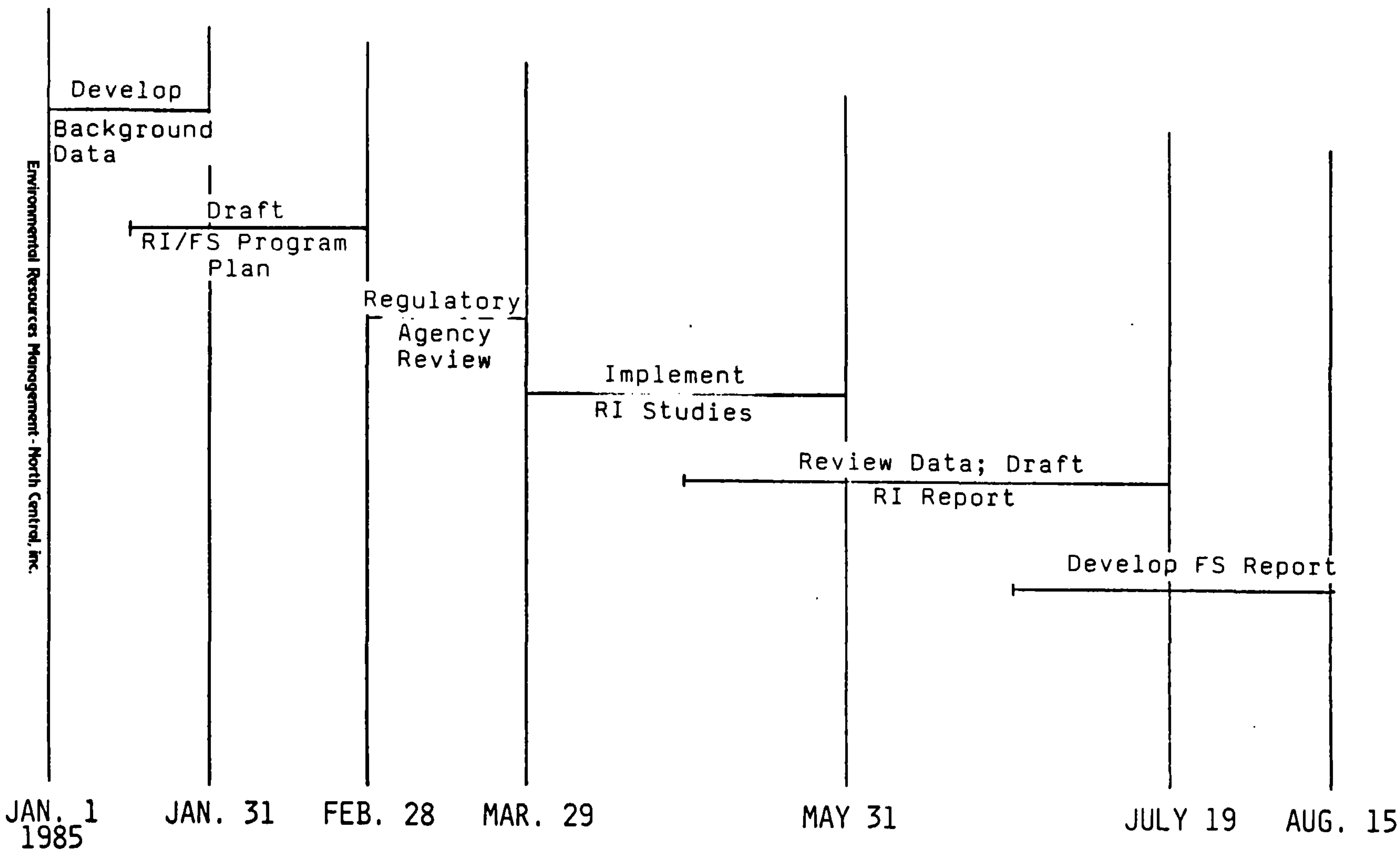
A Remedial Investigation Report will be prepared which will summarize the results of the environmental monitoring and the data interpretation and endangerment assessment tasks.

2.10 Remedial Investigation Schedule

Figure 2-6 shows the anticipated project schedule for the overall remedial investigation/feasibility study.

FIGURE 2-6

ANTICIPATED PROJECT SCHEDULE



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SECTION 3
PROJECT SAMPLING PLAN

3.0 INTRODUCTION

This project Sampling Plan is part of a Remedial Investigation at the property owned by DESA Industries, Inc., and operated currently by Continental/Midland. The property is located at 25000 South Western Avenue, Park Forest, Illinois (Figure 3-1). The Remedial Investigation will identify and characterize the source and distribution of chemicals and chemical constituents at, or emanating from, the property, and gather sufficient data and information as a first step to determine the necessity for, and extent of, remedial action at the property. Such remedial action as may prove necessary will be done in accordance with Section 300.69 (f) of the National Contingency Plan, 47 Federal Register, Page 31217 (July 16, 1982).

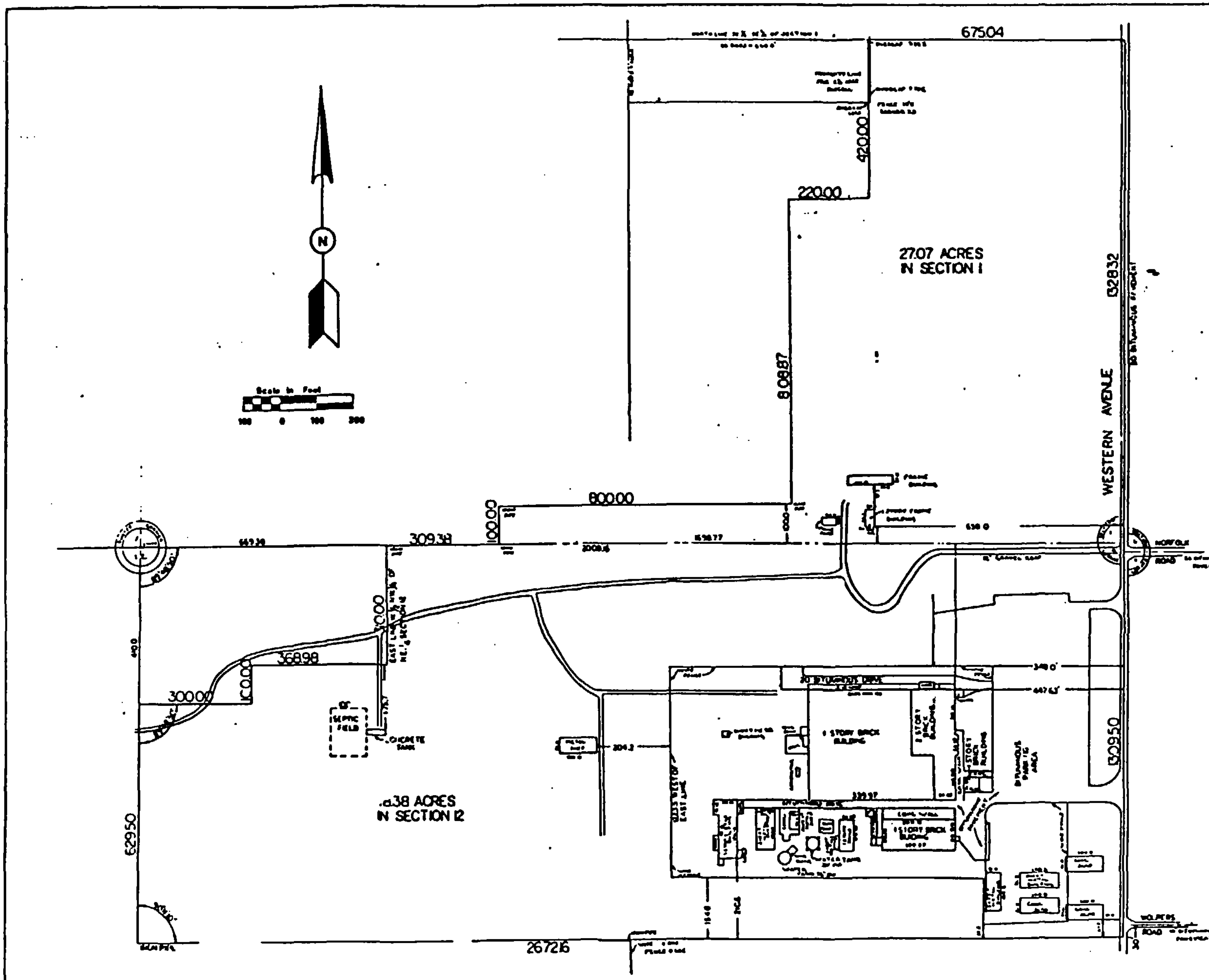
3.1 Objectives

The primary objectives of the Park Forest property Remedial Investigation are:

(1) To characterize and approximate the quantities of any materials found in the soil, ground water or surface water on the property.

(2) To estimate the approximate quantities of potential contaminants.

(3) To evaluate the types and quantities of chemicals migrating from the property.



PLAN VIEW

FIGURE 3-1

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(5) To provide adequate data to support the endangerment evaluation and feasibility study.

The work tasks which comprise the Remedial Investigation are outlined in subsequent segments of the Project Sampling Plan.

3.2 Project Personnel

Key personnel for the Remedial Investigation are:

Title	Name	Company	Address
Project Manager	J. W. Polich	ERM	Palatine, IL
Quality Assurance Manager	R. O. Ball, Ph.D.	ERM	Palatine, IL
Project Engineer	F. J. Blaha	ERM	Palatine, IL
Project Hydrogeologist	P. Gruber	ERM	Palatine, IL
Drilling Subcontractor	B. Fox	Canonie Const.	Itasca, IL
Leak Testing	E. Schulster	Hunter Envr. Services	Schaumburg, IL
Analytical	J. Logsdon	Rocky Mountain Analytical	Arvada, CO

Mr. Gruber, as project hydrogeologist will directly supervise all field soil and subsurface investigations.

3.3 Field Activities

The field investigation will consist of a data survey, boring program, soil analyses, surface water sampling program, potable water sampling, and, if required well installation, and ground water sampling program. Any borings for monitoring well installation will be installed by experienced crews. The estimated schedule for the Remedial Investigation is presented in the Remedial Investigation Work Plan. It is expected that the data survey will be completed prior to the other field activities. The boring, well installation, and sampling program will then be conducted. The individual work tasks of the Remedial Investigation are discussed in subsequent sections of this Project Sampling Plan.

3.3.1 Data Surveys

Data surveys can provide a relatively rapid means for mapping subsurface conditions. Base data will be obtained from the Illinois water and geological surveys, the United States Geological Survey, the Soil Conservation Service, local well drilling contractors, and aerial photographs.

3.3.2 Boring Program

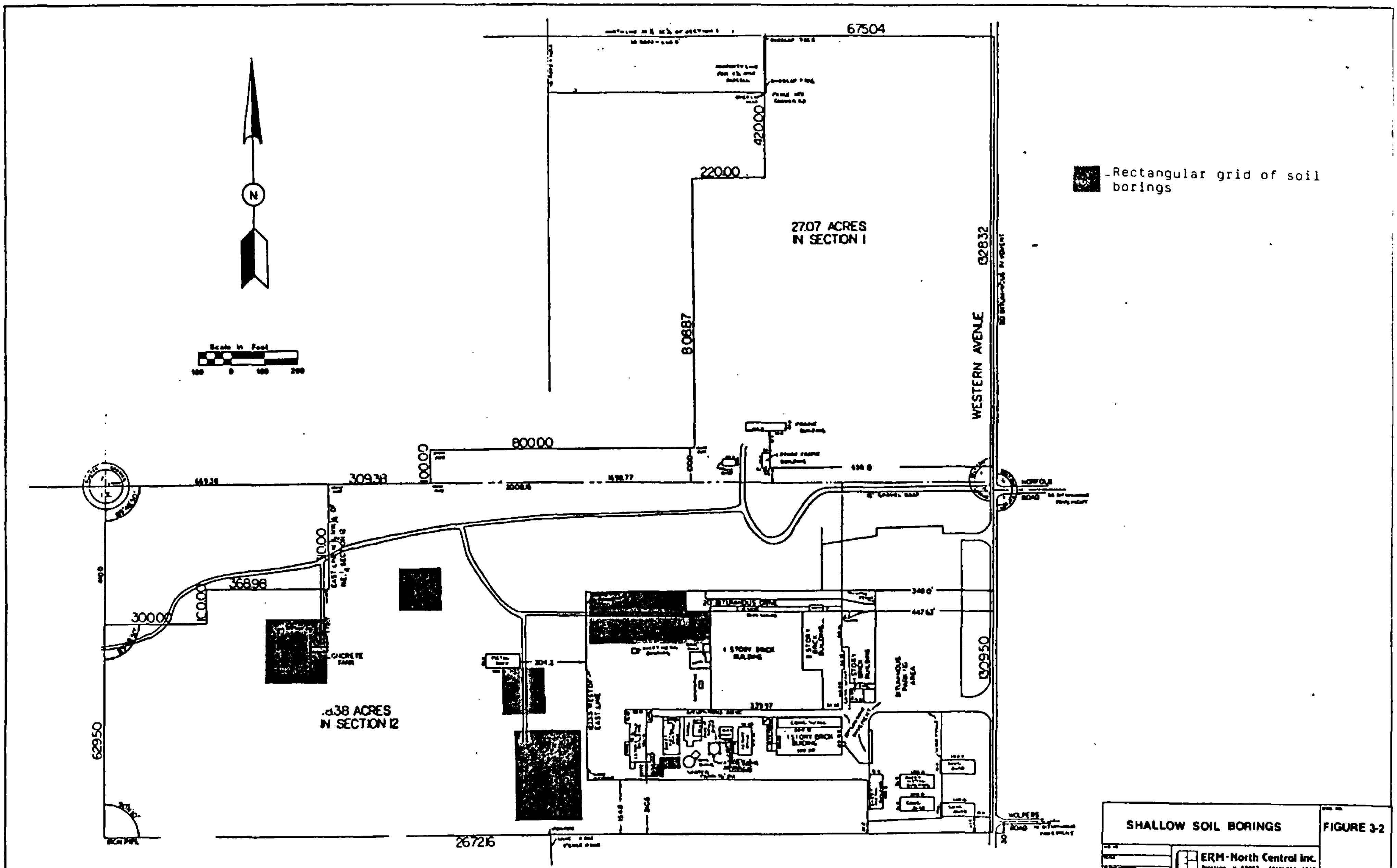
The purpose of the sampling program is to evaluate the lateral and vertical extent and distribution of chemicals on the property. During the initial stages of the investigations, the majority of samples will be soil samples obtained from soil borings or backhoe pits. Each bore hole will be logged by a registered geologist to provide a physical description and visual characterization of the materials encountered.

Shallow soil borings and backhoe pits will be completed and soil samples analyzed before any deep boreholes are installed. Deep boreholes and monitoring wells will be installed only if analytical results from the shallow soil sampling program show that further studies are necessary. The location and number of any such deep boreholes and/or monitoring wells will be based on the analytical results.

Depth to water or free liquid levels will be measured whenever present in a boring or pit. At least one sample of the water or free liquids will be obtained for laboratory analysis.

3.3.2.1 Shallow Soil Sampling

Unsaturated zone soil samples, including surface soil, will be collected from the areas indicated on Figure 3.2. A rectangular grid will be used to locate each particular shallow soil boring in the indicated areas. The distance



SHALLOW SOIL BORINGS

FIGURE 3-2

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between nodes on the grid will be determined by the accuracy desired for that area. Soil samples from four to six borings will be composited for analytical work, again dependent on the desired accuracy of results. Composite soil samples will be logged, placed in glass containers, labeled, and placed on ice for shipment to the analytical laboratory. These samples will be shipped under chain-of-custody procedures labelled as "Unanalyzed Samples of Hazardous Waste from Other Than Closed Containers" for shipping purposes.

In order to find all potential hot spots in an area within a given level of confidence, a specific grid spacing will be required. Likewise, the probability of finding a hot spot of a certain size can be determined given a particular grid spacing. The sampling grid developed will be based upon an understanding of the property history and the potential for contamination. The sampling grid currently being considered is a systematic grid and covers only those areas likely to have contamination. A description of the griding methodology is included in Appendix D. A sufficient number of random samples will be collected from other areas around the plant to ensure that, within a certain level of confidence, the remainder of the property is free from contamination.

3.3.2.2 Deep Soil Sampling

The boreholes from which deep soil samples will be obtained will be located based on the results of the shallow soil sampling and backhoe test pit program and geophysical studies. These boreholes will serve both as soil sampling and ground water monitoring well locations up and downgradient from any contaminated areas.

The soil profile in all deep borings will be logged continuously by a qualified geologist. Split spoon samples will be collected continuously in at least one boring. In each successive boring, samples will be collected at five foot intervals.

Selected soil samples obtained from the split spoon sampling of each deep boring will be sent to the laboratory for analysis. Monitoring wells will be constructed in each boring and screened at the first continuous water bearing unit beneath the property. A minimum of 10 feet of well screen will be inserted in each boring and extend at least two feet above the local water table. The well construction will be as shown in Figure 3-3.

3.3.2.3 Ground Water Sampling

At least three sets of ground water quality samples will be collected from any wells installed. Each well will be developed to remove fine grained materials and drilling fluids introduced into the formation during drilling. Well development will be performed using either a PVC bailer or a submersible pump. A minimum of three well volumes of water will be removed from each well. Temperature, pH, and specific conductance will be monitored during development. Development will be terminated upon stabilization of these measurements.

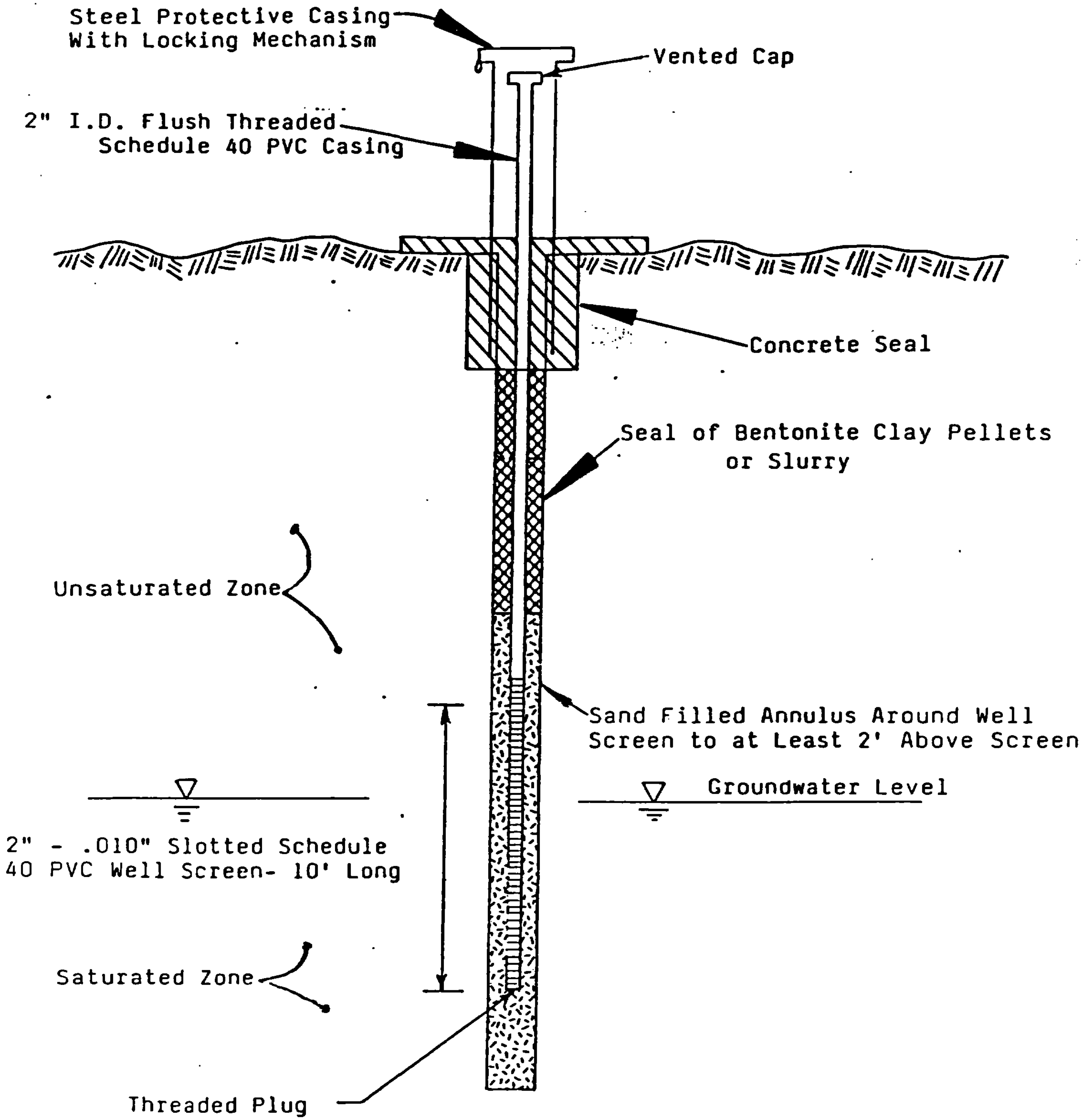
In order to remove potentially stagnant ground water, stratified fluids, or residual chemicals, any well to be sampled will be flushed prior to sampling until pH, temperature, and specific conductance have stabilized. Well flushing will be accomplished by removing a minimum of three well volumes of water. Ground water samples will be obtained from each well within twenty-four hours of this flushing. The water samples will then be placed in their respective containers.

The volatile fraction sample from each boring will be placed in two 40-ml vials with Teflon® Septums. Each vial will be filled to the septum, sealed and then inverted to check for air bubbles. Should air bubbles appear, the process will be repeated until an air-free sample is obtained.

Where split samples are obtained, the first bail of water will be used to rinse the sample containers. Subsequent bails will be used to place equal portions of water in the containers for each sample. The process will be repeated until the containers are full.

3.3.2.4 Surface Water Sampling

Surface water samples will be collected using a grab type sampler. All surface water samples will be monitored for pH, temperature, and specific conductance to determine the recharge/discharge relationship to ground water. Before collecting each sample, the sampling device will be thoroughly cleaned and decontaminated. The sampler will be rinsed with tap water and then rinsed with the water to be sampled.



NOTE: Not to scale.

TYPICAL WELL INSTALLATION

DWG. NO.

FIGURE 3-3

W.O. NO.

SCALE

CLIENT APPROVAL

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Palatine, IL 60067 (312) 934-4646

SHEET OF

Immediately after collection, the samples will be placed in the appropriately sized containers, preserved, and inserted into sample shuttles and put on ice. The analytical parameters dictate the type and size of subsample containers, and the preservative. The type of sample containers and preservatives used will conform to those listed in Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, March 1983.

Special care will be taken with the subsamples to be analyzed for volatile organic compounds. The protocol for volatile fraction sampling will be the same as that described for ground water sampling.

Surface water samples will be analyzed for the constituents listed in Table 3-1 at the locations indicated in Figure 3-4.

3.3.2.5 Sample Handling and Shipment

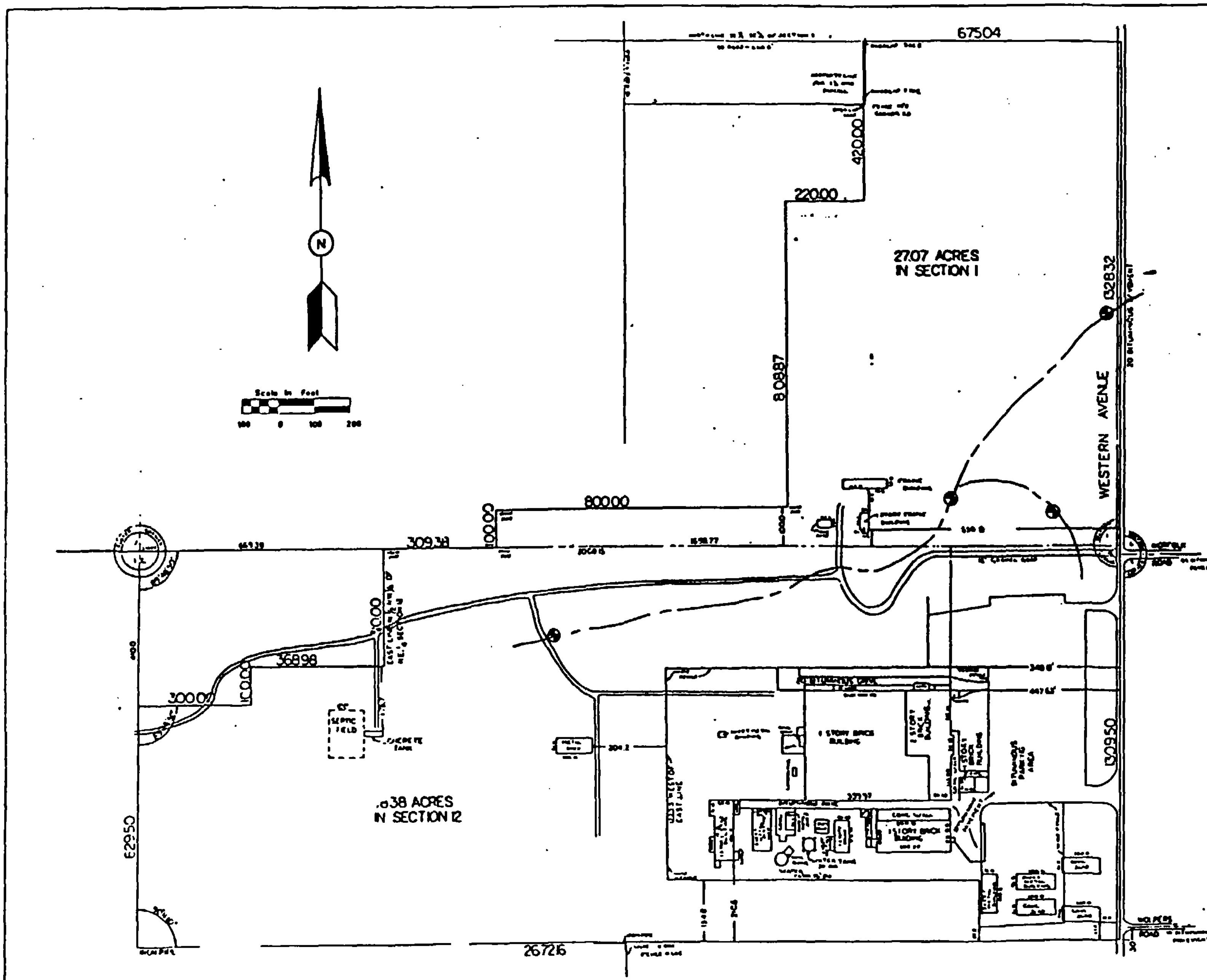
The soil and water samples will be logged and labelled in the field. All observations and labels will be recorded in a field notebook.

Soil compositing will be accomplished by placing portions of the samples to be analyzed in large disposable aluminum pans for mixing prior to sampling. The composite sample will then be placed in a glass sample container. This container will be tightly filled and labelled, sealed in a plastic bag and placed in a cooler cushioned with absorbent material. All samples will be maintained under chain-of-custody

TABLE 3-1

GROUND/SURFACE WATER SAMPLE
PARAMETERS

Field	Laboratory
Temperature	Volatile Organic Compounds
pH	Polychlorinated biphenyls
Specific Conductivity	Cyanide
	Arsenic
	Barium
	Cadmium
	Chromium
	Copper
	Lead
	Magnesium
	Mercury
	Molybdenum
	Nickel
	Selenium
	Zinc



SURFACE WATER AND SEDIMENT SAMPLING

FIGURE 3-4

ERM-North Central Inc.

protocol through shipment to the analytical laboratory (within one week of collection). Each sample container will be marked with a label similar to the one shown in Figure 3-5 which provides the sample number, location, date, time, and the analyses to be performed on the sample. A chain-of-custody form will accompany each cooler or carton of samples shipped to the lab and each group of sample splits transferred to the requesting agency. An example chain-of-custody form is shown on Figure 3-6.

The sample container will be shipped via express mail service to the analytical laboratory. The samples will be considered "Unanalyzed Samples of Hazardous Wastes from Other than Closed Containers" for purposes of shipment and applicable regulations will be followed.

All samples obtained during the investigation will be retained for possible future analyses.

3.3.3 Decontamination

Equipment decontamination will be required to control the possible movement of contaminants to clean areas, prevent the cross contamination of bore holes and samples, and assist in maintaining the health and safety of personnel. Decontamination of the drilling and sampling equipment, PVC pipe, screen, and well casing will be required.

The decontamination effort will be subdivided into two phases. The first phase, accomplished prior to drilling, will consist of a thorough cleaning of the rear portion of the drill rig, drill rods and bits, threads, sampling

FIGURE 3-5. SAMPLE LABEL

SAMPLE NO. ____________________
PROJECT NO. ____________________
PERSONNEL ____
____

DATE ____________________ TIME ______________
COMPOSITE ____________________ GRAB ______________

TYPE: SOIL _____ WATER _____ SLUDGE _____
OTHER (EXPLAIN) ____________________________________

ANALYSIS

PP Volatiles	____________	SO_4	____________
PP B/N	____________	Cl	____________
PP Acids	____________	Total CN	____________
PP Pesticides	____________	NO_3	____________
Metals	____________	pH	____________
COD	____________	Spec Cond	____________
TDS	____________	Hex Cr	____________
TOH	____________	Free Lime	____________
TOC	____________	Other	____________
CO_3 HCO_3	____________	Preservatives	____________

FIGURE 3-6

CHAIN OF CUSTODY RECORD

Project Name ____________________ Collector's Sample No. ____________________

Project Number ____________________ ____________________

Site: ____

Location of Sampling: ____

Type of Sample ____

Company's Name ____________________ Telephone (   ) ____________________

Address ____
number street city state zip

Volume Collected ____________________ Number of Containers ____________________

Collector's Name ____________________ Telephone (   ) ____________________

Signature ____________________

Date Sampled ____________________ Time Sampled ____________________ (am/pm)

Field Information ____

____

____

Relinquished By: ____________________ Date/Time: ____________________

Received By: ____________________ Date/Time: ____________________

Relinquished By: ____________________ Date/Time: ____________________

Received By: ____________________ Date/Time: ____________________

Relinquished By: ____________________ Date/Time: ____________________

Received By: ____________________ Date/Time: ____________________

Authorization For Disposal ________ Date/Time: ____________________

Disposed By: ____________________ Date/Time: ____________________

equipment, PVC pipe, screen, and the well casing. This cleaning will consist of a preliminary rinse using high-pressure potable water to remove encrusted soil. The equipment and materials will then be steam washed with detergent and potable water and then steam rinsed with potable water.

The second phase of the decontamination process will be the cleaning of drilling equipment between holes. The drill rods and bits and reusable sampling equipment will be rinsed with high-pressure water to remove mud and then steam rinsed. Care shall be exercised by all personnel involved to prevent cross contamination of the bore holes.

The sample bailers, which are dedicated to each well, will be cleaned with acetone, then cleaned with Alconox and water, and finally rinsed with distilled water and packaged in a plastic container. The sample bailers will be placed in decontaminated sections of PVC pipe with end caps while the wells are being flushed prior to sampling. Ground water samplers will be required to wash their gloves in Alconox and water and rinse them in distilled water prior to obtaining each sample.

3.4 Analytical Requirements for Soil and Water Samples

The soil samples will be submitted to an analytical laboratory for the analyses listed in Table 3-2.

TABLE 3-2

SOIL SAMPLE
PHYSICAL/CHEMICAL PARAMETERS

Physical	Chemical
Unified Soil Classification	Volatile Organic Compounds
Permeability	Polychlorinated biphenyls
	Cyanide
	Arsenic
	Barium
	Cadmium
	Chromium
	Copper
	Lead
	Magnesium
	Mercury
	Molybdenum
	Nickel
	Selenium
	Zinc

The laboratory QA/QC Program is based upon the quality assurance guidelines provided in the following government publications:

"Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019. March 1979;

National Enforcement Investigation Center Policies, and Procedures Manual, EPA-330/9/79/001-R, October 1979;

The recommended guidelines for EPA Methods 624 and 625. (Federal Register, December 3, 1979, pp. 69532-69559);

"Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," EPA 600/8-80-038, June 1980; and

"Determination of 2,3,7,8-TCDD in Soil and Sediment," EPA, Region VII, Kansas City, September 1983.

To monitor analytical laboratory performance, blank, spike, or duplicate samples will be submitted with the samples collected in the field. The purpose of the field QC samples is to provide additional data to monitor the accuracy and repeatability of the laboratory analyses. It is believed that the combined laboratory and field QC procedures will provide an adequate data base for evaluation of analytical data. The spike samples will consist of typical sample materials spiked with organic or metal constituents. One duplicate or spike sample will be submitted to the analytical laboratory for every ten samples.

3.5 Safety

All field activities will be conducted in accordance with the Project Safety Plan.

3.6 Documentation and Reporting

Field activities will be recorded daily in the field activities logbook. Sample numbers and airbill numbers, sampling date and times and the physical characteristics of the samples will be recorded in the sample logbook.

SECTION 4

PROJECT SAFETY PLAN

4.0 INTRODUCTION

This Section presents the safety procedures to be followed during the Remedial Investigation, and all subsequent work performed on, or adjacent to, the Property, to protect the health and safety of field personnel.

4.1 General Information

The following information is provided to acquaint personnel with the names and responsibilities of designated safety personnel, emergency agency telephone numbers, the nature of potential health and safety hazards, as well as general rules pertaining to activities in the field.

4.1.1 Project Safety Officer

The Project Safety Officer (PSO) is responsible for daily supervision of all safety, decontamination and environmental monitoring activities associated with the remedial investigation. The PSO is also charged with assuring that all remedial investigation personnel comply with the provisions of this plan in the field. The PSO has the authority to stop work in the event of an emergency (or safety plan violation), to start work following any stoppage, and to approve modifications to safety plan requirements based upon field conditions.

4.1.2 Emergency Agencies

A list of emergency telephone numbers is provided below and will be posted at the Site:

Ambulance - Park Forest Ambulance Service, (312) 756-5151

Fire - Park Forest Fire Department, (312) 756-5151

Police - Park Forest Police Department, (312) 756-5151

Hospital - St. James Hospital, Chicago Heights, (312) 756-1000

4.1.3 Key Personnel

Title	Name	Company	Telephone
Project Manager	J.W. Polich	ERM	(312) 934-4646
Project Safety Officer	P. Gruber	ERM	(312) 934-4646
Back-Up Project Safety Officer	F. J. Blaha	ERM	(312) 934-4646

4.1.4 Nature of Potential Hazards

4.1.4.a Chemical

The manufacturing operations associated with the property involved large volumes of metals with associated oils and degreasing operations. Previous operations at the plant also involved metal processing including surface preparation (degreasing, cleaning) and final finishing (plating, painting).

Based upon available information, the following potential hazards have been identified as being of concern for personnel:

- o Buried saw blades and other discarded metal objects
- o Buried reactive materials (magnesium chips)
- o Caustic contamination of soil and ground water
- o Contamination of soil with heavy metals (paints and paint sludges)
- o Potential exposure to PCB's (previous analytical results)
- o Puncture of buried drums
- o Exposure to cutting oils and other oils or vapors
- o Puncture of underground piping
- o Buried electrical utility lines

Available information indicates that the hazards presented by the property to remedial investigation personnel are minimal. The major hazard to personnel is considered to be exposure to soil and water potentially contaminated with hazardous constituents, of which heavy metals are of the most concern. Since volatile organics have not been disposed on the property since at least 1968 when DESA began operation, and since no past operations involving the burial of filled and sealed drums is known of, it is expected that volatile organic compounds will have largely volatilized. Furthermore, any reactive materials are believed to have been largely spent.

4.1.4.b Physical

There is a risk associated with injury resulting from contact with the equipment and facilities as well as the equipment used during the investigation. Personnel are cognizant of the fact that any protective apparel worn may limit visibility, hearing and manual dexterity. In addition, if protective equipment is required, (e.g., Tyvek coveralls and respirators) this may place a physical strain on the wearer.

4.1.5 Sample Handling and Analyses

The procedures to be followed for handling and shipping samples, and a description of the project analytical requirements are contained in the Project Sampling Plan and the Remedial Investigation Work Plan.

4.2 General Work Procedures

Industrial operations at the plant are still on-going and all remedial investigation work will be performed during normal working hours. Remedial investigation work will not take place within industrial buildings still in use. Remedial investigation work will take place outside all industrial buildings. Normal plant safety procedures will be observed during all remedial investigation work.

Entry and exit procedures will be those procedures normally used except that the PSO will require workers and other personnel near on-going remedial investigation activities to wear required protective clothing and to observe all necessary safety precautions. All industrial buildings are surrounded by a security fence which does not, however enclose all the surrounding property owned by DESA. Entry to the industrial manufacturing area is restricted by security guards who require adequate identification and clearance.

In the event of an accident, exposure to contamination or other emergency, the PSO will stop work and determine the actions to be taken. Remedial investigation personnel working should immediately leave the area (but remain in their protective gear). Injured personnel may be removed from any immediate hazard.

If an evacuation is ordered by the PSO, personnel may be instructed to leave by routes other than those normally used.

No eating, drinking or smoking will be allowed near any remedial investigation area. Investigation personnel will go through decontamination procedures for lunch breaks and will be allowed to eat lunch within existing buildings.

4.3 Safety Training

All personnel will be required to attend a training program. The content of this program will include discussions of potential hazards, any required protective equipment, any decontamination procedures (including practice), and the use of monitoring equipment. Field personnel will be required to sign a certificate at the conclusion of the training program.

4.4 Environmental Monitoring Program

During the course of the investigation, ambient air quality will be monitored in the vicinity of any subsurface operations. The following instrumentation and procedures will be used.

4.4.1 Organic Vapor Analyzer (OVA)

An OVA will be used in the survey made to monitor air quality for toxic organic vapors. The instrument to be used is American Gas and Chemical Company, Limited Model 501. At each backhoe location and/or well location, the ambient background reading will first be determined upwind. The OVA audible alarm will be set to sound when readings exceed 4 parts per million (ppm) above the background reading.

In the event of elevated readings, personnel will move away from the immediate area while the PSO takes further readings. The PSO will assess the situation and determine actions to be taken.

4.4.2 Combustible Gas Monitor

A combustible gas monitor will be used during drilling operations in areas where solvent disposal is suspected. The instrument to be used is Gastech Incorporated Model GP-204. The instrument can be positioned to continually monitor the ambient atmosphere; if bore holes are to be installed, they will be monitored periodically. A reading of 25 percent of the Lower Explosive Limit (LEL) will be considered the maximum allowable for continuation of work. If the reading exceeds 25 percent LEL, drilling will stop, personnel will move away from the immediate area and the PSO will be notified. After assessing the situation, the PSO will take appropriate actions. All readings (background and monitoring) will be recorded by the PSO in a logbook. The time, date, weather conditions, boring number and other pertinent observations will be recorded with the readings.

4.5 Communications

The plant is equipped with telephone service for both local and long distance calls. This telephone system will be used to request help or back-up equipment in the case of an emergency situation. The security guards have access to both this telephone system and to the plant official with the authority to request outside help. Therefore, the investigation team will be supplied with two-way radios so that the security guards may be contacted at any time from any location.

4.6 Required Protective Equipment

The type of protective gear required is dependent upon the nature and location of the work performed and the past history and use of that location. Based on the property history and preliminary reviews the following level of protection is to be worn for all investigative work.

The equipment includes:

- o White tyvek coverall
- o Neoprene or PVC work boots
- o Neoprene or nitrile work gloves
- o Hard hat
- o Safety glasses

The PSO has the authority to modify required levels of protection in response to field conditions. The PSO may restrict access as he deems necessary regardless of the protective gear worn.

4.7 Decontamination Procedures

4.7.1 General Information

Decontamination of equipment and personnel will be performed to extend the useful life of the safety equipment, and to limit the migration of any contaminants both off the property and between work areas.

All drilling equipment and other tools, and all well materials, will be cleaned prior to entry to remove grease, oil, encrusted dirt or other materials. Special attention will be given to the rear portions of drill rigs, auger flights and drill rods (inside and outside), and sampling tools. An inspection of all rigs will be made by the project manager and PSO prior to approving equipment for use.

Water obtained from water production wells on the property will be chemically analyzed before the field work begins. If these water samples are shown to be uncontaminated with hazardous constituents, then the production well water can be used for decontamination of equipment and personnel.

4.7.2 Equipment Decontamination

All reusable sampling equipment, auger flights, and any other tools used for intrusive work will be decontaminated between borings. Cleaning will consist of scrubbing to remove encrusted materials followed by a soap-and-water wash and potable water rinse using a high-pressure hot water or steam cleaning unit. Additional rinses with other compounds, such as organic solvents, may be used if warranted by the nature of the waste materials.

Following decontamination, the clean equipment will be stored on plastic sheeting and/or sawhorses if not immediately reused. This equipment will also be covered with plastic.

At the conclusion of work, all drilling rigs will be thoroughly cleaned using the method previously described.

4.7.3 Personnel Decontamination

Decontamination of personnel will be performed at existing plant facilities. Personnel decontamination will consist primarily of soap-and-water hand washings to remove contaminants, followed by doffing of the gear. Coveralls and gloves should be removed by turning the items inside out. The general sequence of doffing procedures is outlined below. The extent of washing required, or modifications to the sequence, may be specified by the PSO.

Steps in decontamination will be:

1. Wash work gloves and boots;
2. Rinse work gloves and boots;
3. Remove boots and gloves;
4. Remove Tyvek coverall.

4.7.4 Containerization of Decontamination By-Products

Gloves and coveralls will be changed daily and will be disposed of in a separate plastic bag, sealed, and disposed of with the general plant refuse.

4.7.5 Containerization of Drilling By-Products

Auger cuttings and any drilling fluids generated will be drummed and stored on the property until the analytical results are obtained. If the analytical results indicate the material is classified as a hazardous waste, they will be disposed of at an approved facility.

4.8 Personnel Safety Certification

All personnel are required to sign and date the attached certification prior to working on the property (Attachment 4.1). The document will be retained in the project files.

ATTACHMENT 4.1

PERSONNEL SAFETY CERTIFICATION

Safety Plan Certification

All project personnel are required to make the following certification prior to conducting work at the AMCA Park Forest Property.

I ____________________ certify that:

1. I have read and understand the Project Safety Plan, and that

2. I will abide by the provisions of the Project Safety Plan.

3. I have attended the Project Safety Training program provided by ERM-North Central.

____
Signature

____
Date

SECTION 5
QUALITY ASSURANCE PLAN

5.0 PROJECT DESCRIPTION

The primary objectives of the Remedial Investigation at the Park Forest property are:

1. To determine if soil, subsoils and ground water are contaminated.

2. If so, to characterize the type of contamination and estimate the approximate quantities of materials.

3. To assess the impact of any such contamination on potential receptors.

4. To provide adequate data to support an endangerment evaluation and feasibility study.

The Remedial Investigation will be performed by:

Environmental Resources Management-North Central, Inc.
835 Sterling Avenue
Palatine, IL 60067
(312) 934-4646

5.1 Project Sampling Program

Table 5-1 is a listing of laboratory analysis for the various samples to be obtained.

5.2 Analytical Procedures

Laboratory analysis of soil, potable water, surface water, and ground water will be performed by Rocky Mountain Analytical Laboratory (RMA), Arvada, Colorado. The laboratory has an extensive QA program. The existing quality assurance protocol of RMA is based upon the following government guidelines:

> "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979;
>
> National Enforcement Investigation Center Policies, and Procedures Manual, EPA-330/9/79/001-R, October 1979;
>
> The recommended guidelines for EPA Methods 624 and 625. (Federal Register, December 3, 1979, pp. 69532-69559);
>
> "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," EPA 600/8-80-038, June 1980; and
>
> "Determination of 2,3,7,8-TCDD in Soil and Sediment," EPA, Region VII, Kansas City, September 1983.

Appendix B includes RMA laboratory methodologies and a description of their quality assurance program.

TABLE 5-1

SAMPLING PROGRAM

Parameter	Soil	Water Production Wells	Surface Water	Stream Sediment	Ground Water
Unified Soil Classification	x				
Permeability	x				
Temperature		x	x		x
pH		x	x		x
Specific Conductivity		x	x		x
Volatile Organic Compounds	x	x	x	x	x
Polychlorinated Biphenyls	x	x	x	x	x
Cyanide	x	x	x	x	x
Arsenic	x	x	x	x	x
Barium	x	x	x	x	x
Cadmium	x	x	x	x	x
Chromium	x	x	x	x	x
Copper	x	x	x	x	x
Lead	x	x	x	x	x
Magnesium	x	x	x	x	x
Mercury	x	x	x	x	x
Molybdenum	x	x	x	x	x
Nickel	x	x	x	x	x
Selenium	x	x	x	x	x
Zinc	x	x	x	x	x

Samples will be preserved in accordance with those procedures established in Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, March 1983. Volatile organic samples will be preserved with sodium thiosulfate, and cyanide samples will be preserved with sodium hydroxide. In addition, all aqueous samples will be preserved at 4^{o}C and delivered to RMA the morning after they are collected. Soil samples will be stored at 4^{o}C and will be shipped to the laboratory within one week of collection.

Laboratory quality control procedures for solid and liquid matrices are presented in Appendix E.

To monitor analytical laboratory performance, blank, spike, and replicate samples will be submitted with the samples collected in the field. The purpose of the field quality control samples is to provide additional data to monitor the accuracy and repeatibility of the laboratory analyses. It is believed that the combined laboratory and field quality assurance procedures will provide an adequate base for the evaluation of analytical data.

For soil samples, the spike samples will consist of the sample materials spiked with organic or metal constituents. One replicate or spike sample will be submitted to the analytical laboratory for every ten soil samples.

For surface water and ground water samples, the blank samples will consist of distilled water. The spike samples may be prepared from distilled water or replicate samples spiked with organic constituents. One quality control sample will be submitted to the analytical for every ten potable, surface or ground water samples.

5.3 Project Organization and Responsibility

5.3.1 Sampling Quality Control

Frank Blaha, ERM. Responsibilities will include maintenance of chain-of-custody on all samples collected, verification with sampling team personnel of sampling techniques and quality control procedures prior to field activities. Responsible for prompc review of any quality control deviation utilized in the field.

5.3.2 Laboratory Quality Control

John Logsdon, RMA. Responsibilities will include supervision of sample analyses of soil, potable, surface and ground water. Responsible for quality control procedures and quality control checks at RMA.

5.3.3 Data Analysis and Quality Control

Roy O. Ball, Ph.D., P.E., ERM. Responsible for all data review, validation and interpretation involved in this project.

5.3.4 Overall Quality Assurance

Roy O. Ball, Ph.D., P.E., ERM. Responsible for implementing the Quality Assurance Plan for this project.

5.4 Data Quality Requirements and Assessments

5.4.1 Data Representativeness

When sampled, monitoring wells will have three to five well volumes removed prior to collecting a sample to ensure that a representative sample has been obtained from the aquifer. Subsurface soil samples will be obtained from vertical depths in the soil column which are most likely to be contaminated or contain pore fluids other than water. As such, these samples will be representative of subsurface conditions. Each surface soil sample will be composited from four or five nodes of a system to ensure a representative sample. Surface water samples will be obtained using a grab-type sampler. The sample will be representative of surface water conditions.

5.4.2 Data Comparability

All aqueous sample data will be reported in ug/l(ppb). All soil samples will be reported in terms of mg/kg(ppm). Sampling protocol will be strictly adhered to.

5.4.3 Data Completeness

Less than 100 percent of the samples may be collected due to well accessibility problems and poor recovery of soils in split spoon samplers. The valid data required from the laboratory will be 90 percent of the samples submitted.

5.5 Sampling Procedures

Sampling procedures are provided in the Project Sampling Plan and the Remedial Investigation Work Plan.

5.6 Sample Custody Procedures

Sampling team personnel will perform all sampling and will retain custody until shipment to the laboratory. For all samples, a chain-of-custody form (Figure 5.1) will be used for each shuttle and for each group of sample splits transferred to others.

The field activities will be recorded daily in the field activities logbook. An outline of the requirements for field logbook entries is given in the Project Sampling Plan. The following information will be recorded in the sample logbook:

1. Exact sample location.

2. Name of sampler and witness.

3. Date and time of sample collection.

4. Sample number and airbill number.

5. All sampling conditions, i.e., type of material, weather, type of sampling container and preparation, description of sampling procedure, preservation, and shipping.

6. Field measurements of pH, temperature, salinity, specific conductance, and volume and

FIGURE 5.1

CHAIN OF CUSTODY RECORD

Project Name ____________________ Collector's Sample No. ____________________

Project Number __________________ ____________________

Site: ____

Location of Sampling: ____

Type of Sample ____

Company's Name __________________ Telephone ( ) ____________________

Address ____
number street city state zip

Volume Collected ________________ Number of Containers ________________

Collector's Name ________________ Telephone ( ) ____________________

Signature _______________________

Date Sampled ____________________ Time Sampled ________________ (am/pm)

Field Information ____

____

____

Relinquished By: ________________ Date/Time: ____________________

Received By: ____________________ Date/Time: ____________________

Relinquished By: ________________ Date/Time: ____________________

Received By: ____________________ Date/Time: ____________________

Relinquished By: ________________ Date/Time: ____________________

Received By: ____________________ Date/Time: ____________________

Authorization For Disposal _______ Date/Time: ____________________

Disposed By: ____________________ Date/Time: ____________________

characteristics of water removed during the development and flushing of wells.

RMA will provide all sample containers necessary for field sampling and QC requirements. Each lot of sample containers will be checked for cleanliness by the laboratory and closed to prevent contamination. Following sampling, each container will be labeled to indicate sample number, location, time and date, the analyses to be performed on the sample and packaged to prevent breakage. Field blanks, spike samples, custody seals, etc. will be added as required by the analytical procedures.

During the field studies, samples are received at the laboratory by the sample custodian who examines each sample to ensure that it is the expected sample, inspects the sample containers for possible damage, and ensures that the documentation is complete and adequate. The sample custodian will ensure that each sample has been preserved in the manner required by the particular test to be conducted and stored according to the correct procedure. Preservation and storage will require maintenance of 4°C until analysis begins.

5.7 Calibration Procedures and Preventive Maintenance

A maintenance, calibration, and operation program will be implemented to ensure routine calibration and maintenance will be performed on all field instruments. The program will be administered by the Project Safety Officer (PSO). The PSO will perform any scheduled monthly and annual calibration and maintenance and will perform field calibrations, checks and instrument maintenance prior to use.

Team members will be familiar with the field calibration, operation, and maintenance of the equipment, maintain such proficiency, and will perform the prescribed field operating procedures outlined in the Operation and Field Manuals, accompanying the respective instruments, and keep a record of all field instrument calibrations and field checks in the field logbook. If monitoring equipment should fail, the Project Safety Officer will be contacted immediately. He will either provide replacement equipment or have the malfunction repaired immediately.

5.8 Documentation, Data Validation, and Reporting

5.8.1 Documentation

Lab sheets, sample labels, and/or field notebooks will carry the following information pertaining to sample I.D.:

1. Sample Identification Number
2. Project Identification Code
3. Sample Location Code
4. Date and time of sample collection
5. Initials of person collecting the sample
6. Analyses to be performed

All field data will be entered into notebooks. Field notebooks, Chain-of-Custody forms, field data sheets, and lab reports will be filed and stored at ERM offices, 835 Sterling Avenue, Palatine, IL.

5.8.2 Data Validation

The precision of the laboratory data will be checked by comparison of the analytical results with the QC samples. The validity of the ground water and surface water data will also be assessed by comparison of blanks, spikes, replicates, and upgradient samples with downgradient and on-site samples. If priority pollutants are detected in the blanks, the priority pollutant data will be invalidated.

The laboratory will critique its own analytical program by the use of spiked addition recoveries, established detection limits for each matrix, precision and accuracy control charts, and by keeping accurate records of the calibration of instruments. RMA establishes average recoveries for surrogates over time, standard deviations, control and warning limits. When a sample recovery is outside the control limit, the sample analysis is repeated. If upon repetition the sample recovery is outside the control limits, the sample will be deemed unsuitable for the method and no further analysis will be conducted on the sample.

5.8.3 Reporting

Data will be reported in the Remedial Investigation Report prepared by ERM.

5.9 Performance and Corrective Actions

Corrective actions for laboratory analyses will be handled by consultation between the Laboratory Quality Assurance Officer and the Project Manager. The Project Manager will make immediate decision with the Laboratory Quality Assurance Officer on new protocols to be followed. All changes in laboratory procedures will be documented and reported in the final report.

Corrective action on a day-to-day basis for field sampling will be handled by consultation between the team members and the Project Manager. The Project Manager will make immediate decisions with the team members on new protocols to be followed. All changes in field sampling procedures will be documented in the field logbook and reported in the final report.

5.10 Quality Assurance Reports

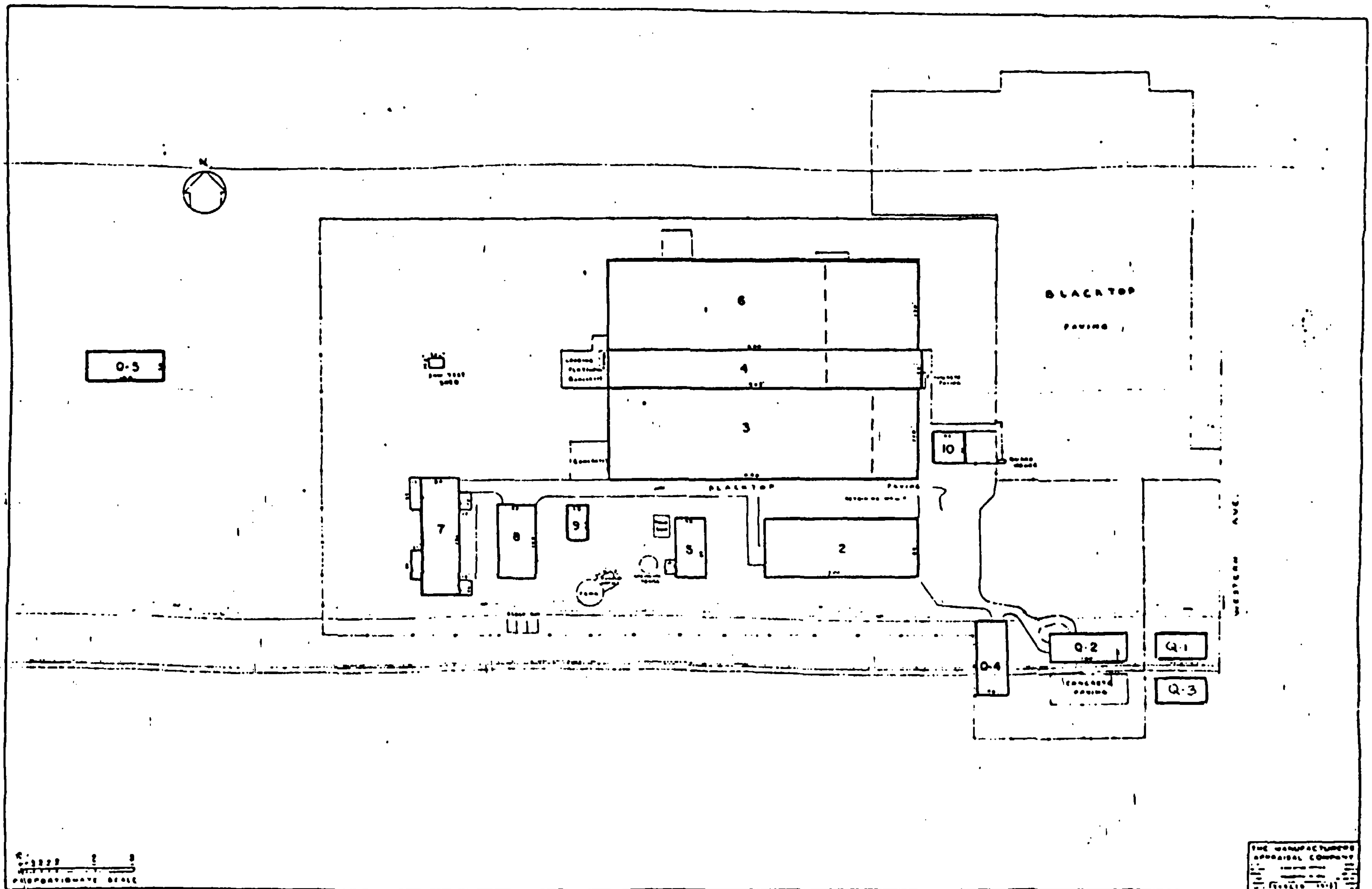
A Quality Assurance Report will be issued by ERM as part of the Remedial Investigation Report. The report will include the results of the performance and document audits and any necessary corrective action procedures. In addition, a data quality assessment will be incorporated into the final report.

APPENDIX A

CURRENT AND PAST BUILDINGS

BUILDINGS:

	ERECTED	DEMOLISHED
Quonset Huts:		
Q-1	1946	1970 (?)
Q-2	1947 (?)	currently in use
Q-3	1946	1970 (?)
Q-4	1946	currently in use
Q-5	1947 (?)	1970 (?)
Buildings:		
#2	1948	currently standing
3	1950	"
4	1957	"
5	1950	"
6	1952	"
7	1957	"
7-A	1984	"
8	1956	"
9	1955	"
10	1951	"



N
Q-5
6
4
3
10
BLACKTOP
PAVING
7
8
9
5
2
Q-4
Q-2
Q-1
Q-3
CONCRETE PAVING
WESTERN AVE.
THE MANUFACTURERS APPRAISAL COMPANY
PROPORTIONATE SCALE

APPENDIX B

PLANT PRODUCTS AND LABELS

CONTINENTAL/MIDLAND

PLANT HISTORY, PRODUCTS AND LABELS

A. MALL TOOL (1947-1956)

(*Items Supplied to Government Were Under Mall Tool Label)

TYPE OF TOOL	LABELS SUPPLIED UNDER		
	MALL	GOV'T.(*)	(POW'R KRAFT) WARDS
1. Pneumatic Tools			
Screw Drivers	x		
Circular Saws	x		
Sanders	x		
Impact Wrenches	x		
Vibrator	x	x	
Hand Grinders	x		
Hand Drills (1/4"-3")	x		
Chain Saws (1P & 6P)	x	6P	
2. Electric Tools			
Belt Sanders	x		
Polishers (7" & 9")	x		
Door Planes	x		
Orbit Sander	x		
Circular Saw (6" - 9")	x	H-97	7 1/4"
Hand Drills (1/4"-3/4")	x	x	1/4" & 1/2"
Chain Saws (Industrial)	x		
3. Flex-Shaft			
Pedestal Grinders & Motors	x		
Hanger Frinders	x		
Flex-Shaft	x		
Flex-Housing	x		
Concrete Vibrators	x		
Generators	x	B-12	
Angle Spindles	x		
Straight Spindles	x		
Wheel Barrow Mountings	x		
4. Railroad Equip.-Flex-Shaft Driven			
Rail Slotters	x		
Rail Grinders	x		
Rail Drills	x		
Angle Spindles	x		
Straight Spindles	x		
5. Miscellaneous			
Gas Chain Saws	x	754	x
Power Trowels	x		
Compactors (Asphalt & Dirt)	x		
Concrete Screeds	x		

PLANT HISTORY, PRODUCTS AND LABELS

B. REMINGTON ARMS (1956 - 1969)

Kept company and "Mall Tool" label as is for two years and then changed their label to "Remingon" and altered product lines per the following lists. Note (*) items supplied to government are now under "Remington" label.

TYPE OF TOOL	LABELS SUPPLIED UNDER		
	REMINGTON	GOV'T. (*)	BELKNAP (BLUEGRASS)
1. Pneumatic Tools			
Chain Saws (2P & 6P)	x	6-P	
2. Electric Tools			
Chain Saws (Industrial)	x		
3. Flex-Shaft			
Pedestal Grinders & Motors	x		
Hanger Grinders	x		
Flex-Shaft	x		
Flex-Housing	x		
Concrete Vibrators	x		
Generators	x	B-12	
Angle Spindles	x		
Straight Spindles	x		
Wheel Barrow Mountings	x		
4. Railroad Equip.-Flex-Shaft Drivn			
Rail Slotters	x		
Rail Grinders	x		
Rail Drills	x		
Angle Spindles	x		
Straight Spindles	x		
5. Gas Tools			
Chain Saws	1-Model	754	x
Power Trowels	x		
Compactors (Asphalt & Dirt)	x		
Concrete Screeds	x		
Rotor Tiller	x		
Snow Blower	x		
6. Powder Actuated Tools			
Stud Driver (Industrial)	x		

PLANT HISTORY, PRODUCTS AND LABELS

C. DESA INDUSTRIES (1969 → 1975)

Kept Remington label and logo for two (2) years. Then had to drop logo and change "Remington" letter styling while continuing to produce under the "Remington" label. (*) items supplied to government are supplied under the new Remington label.

LABELS SUPPLIED UNDER

TYPE OF TOOL	REMINGTON	GOV'T.(*)	WARDS	PENNEY'S
1. Pneumatic Tools				
Chain Saws (1P & 6P)	x	6P		
2. Electric Tools				
Chain Saws (Industrial)	x			
Chain Saws (Domestic) (A)	x		x	x

(A) Also supplied under the following labels: Granja, Alko, Steinmax, Jo-Bo & Nogamatic

TYPE OF TOOL	REMINGTON	GOV'T.(*)	WARDS	PENNEY'S
3. Flex Shaft				
Pedestal Grinder & Motors	x			
Hanger Grinders	x			
Flex-Shaft	x			
Flex-Housing	x			
Concrete Vibrators	x			
Generators	x	B-12		
Angle Spindles	x			
Straight Spindles	x			
Wheel Barrow Mountings	x			
4. Railroad Equip-Flex-Shaft Drivn				
Rail Slotters	x			
Rail Grinders	x			
Rail Drills	x			
Angle Spindles	x			
Straight Spindles	x			

5. Gas Tools	REMINGTON	CHAMPION	DESA	CRAFTSMAN
Power Trowels		x	x	
Compactors (Asphalt & Dirt)		x	x	
Concrete Screeds		x	x	
Concrete Saws		x	x	
Masonary Saws		x	x	
Mortar Mixer		x	x	
Moto-Bugs (Wheel Barrows)		x	x	
Chain Saws (B)	x	x	x	

(B) Also supplied under the following labels: Alpina, Castor, Wards, John Deere, Clinton, Nogamatic, Granja, Steinmax and Alko.

6. Powder Actuated Tools	REMINGTON	CHAMPION	DESA	CRAFTSMAN
Stud Driver (Industrial)	x			
Stud Driver (Domestic) (C)	x			x

(C) Also supplied under the "U-Haul" label

7. Miscellaneous	REMINGTON	CHAMPION	DESA	CRAFTSMAN
Log Splitter		x	x	

D. DESA/AMCA

DESA was acquired by AMCA International Corporation in 1975, continuing operations under the name and management of DESA until 1981 when AMCA's Consumer Products Division took over control of the facility under the name Continental/Midland. By that time, mid-1981, most product lines had been discontinued and the number of employees had been reduced to 35.

From that time until the present (1985) the only product line manufactured at the plant has been a line of powder actuated tools sold under the name "Remington."

APPENDIX C

PLANT PROCESSES

PROCESSES:

Processes with known beginning dates:

Chromium Plating (begun in 1946), ended 1981).

Magnesium Die Casting (1957).

Zinc Electroplating (1960).

Hot Black Oxide (1967)

Cold Black Oxide (1978)

Processes continuously carried on or with Indeterminate Start Up/Shut Down dates:

Copper Plating

Cutting Oils used for machining

Magnesium machining

Heat treating

- Cyanide pot.
- Oil Quench

Electric Motor potting material

Alkaline Cleaners

Caustic Solutions

Trichlorethylene vapor degreasing

Blue seal operation

Paint stripper tank

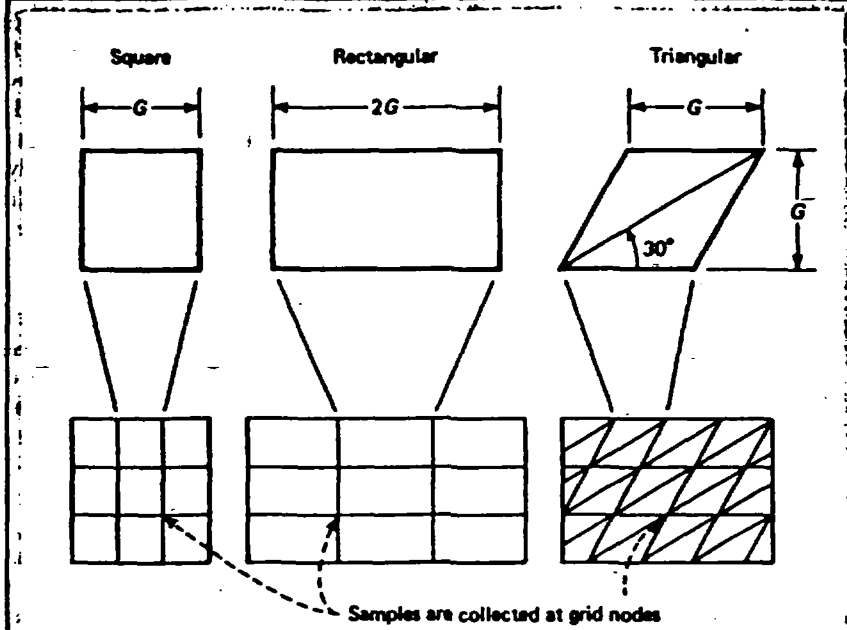
Chrome stripping

Hot and cold glue packaging systems

Silk screening

APPENDIX D

CONTAMINANT SOURCE LOCATION TECHNIQUE



Samples can be collected using one of three grid configurations Fig. 1

Detecting hot spots at hazardous-waste sites

Evaluating the need for remedial cleanup at a waste site involves both finding the average contaminant concentration and identifying highly contaminated areas, or "hot spots." Here is a nomographic procedure to determine the sampling configuration needed to locate a hot spot.

John Zirschky, Clemson University, and Richard O. Gilbert, Pacific Northwest Laboratory

☐ This technique can be used to develop a waste-site sampling plan—to determine either the grid spacing required to detect a hot spot at a given level of confidence, or the probability of finding a hot spot of a certain size, given a particular grid spacing.

The method and an accompanying computer program (ELIPGRID) were developed for locating geologic deposits [1], but the basic procedure can also be used to detect hot spots at chemical- or nuclear-waste disposal sites. Nomographs based on the original program are presented for three sampling-grid configurations—square, rectangular and triangular, as shown in Fig. 1. For other configurations, ELIPGRID may be used. Ref. [2] discusses use of the nomographs when multiple hot spots may be present, and gives a method for finding the probability that a hot spot exists when none was found by sampling.

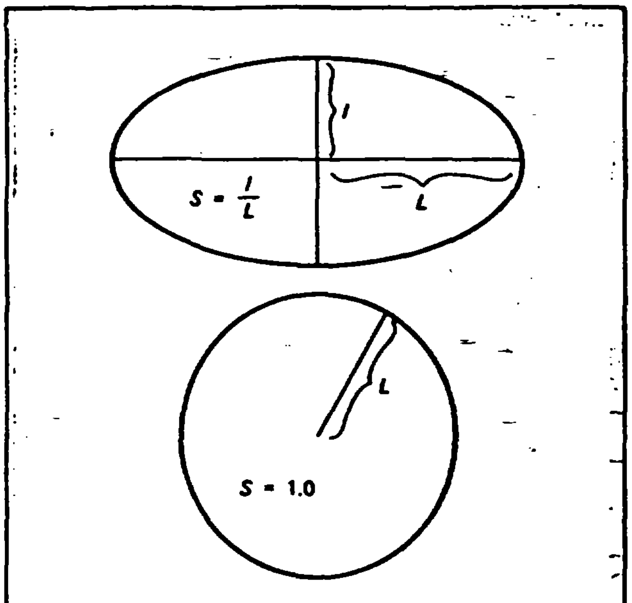
Assumptions

Several assumptions must be made in order to use this technique:

- The hot spot is circular or elliptical in shape or, if it is buried, it projects such a shape to the ground surface.
- The level of contamination that defines a hot spot is clearly specified, so as to eliminate classification errors that will change the probability of detection.
- The orientation of the hot spot with respect to the sampling grid is random. If a specific orientation is suspected, ELIPGRID may be used.
- The sampling points are small compared with the sampling area.

Key parameters

To determine the grid spacing required to locate a hot spot, the size (i.e., the minimum size area of contamina-



Hot spots are assumed to be elliptical or circular in shape — Fig. 2

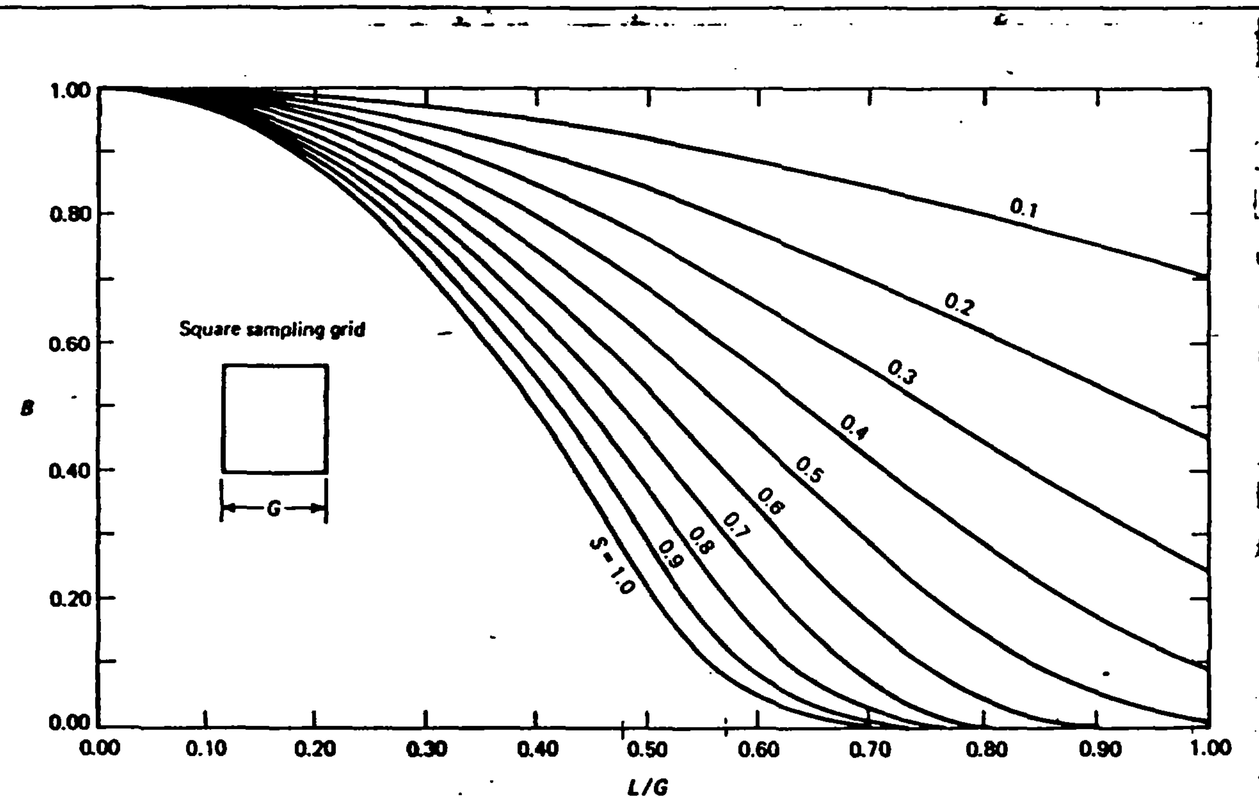
tion that would be of concern) and shape of the spot must be specified. The size of an elliptical target is defined by L = the length of the ellipse's semi-major axis (which is one-half its long axis); and the shape is defined by the ratio of the short axis ($2l$) to the long axis ($2L$), or $S = l/L$ (see Fig. 2.). For a circular target, the radius would specify the size, and the shape would be 1.0. If a particular shape is not suspected, a small value for S should be used, which will result in a closer, and thus more conservative, grid spacing.

Unfortunately, there is no general analytical procedure for selecting the proper hot-spot dimensions. It depends on the situation.

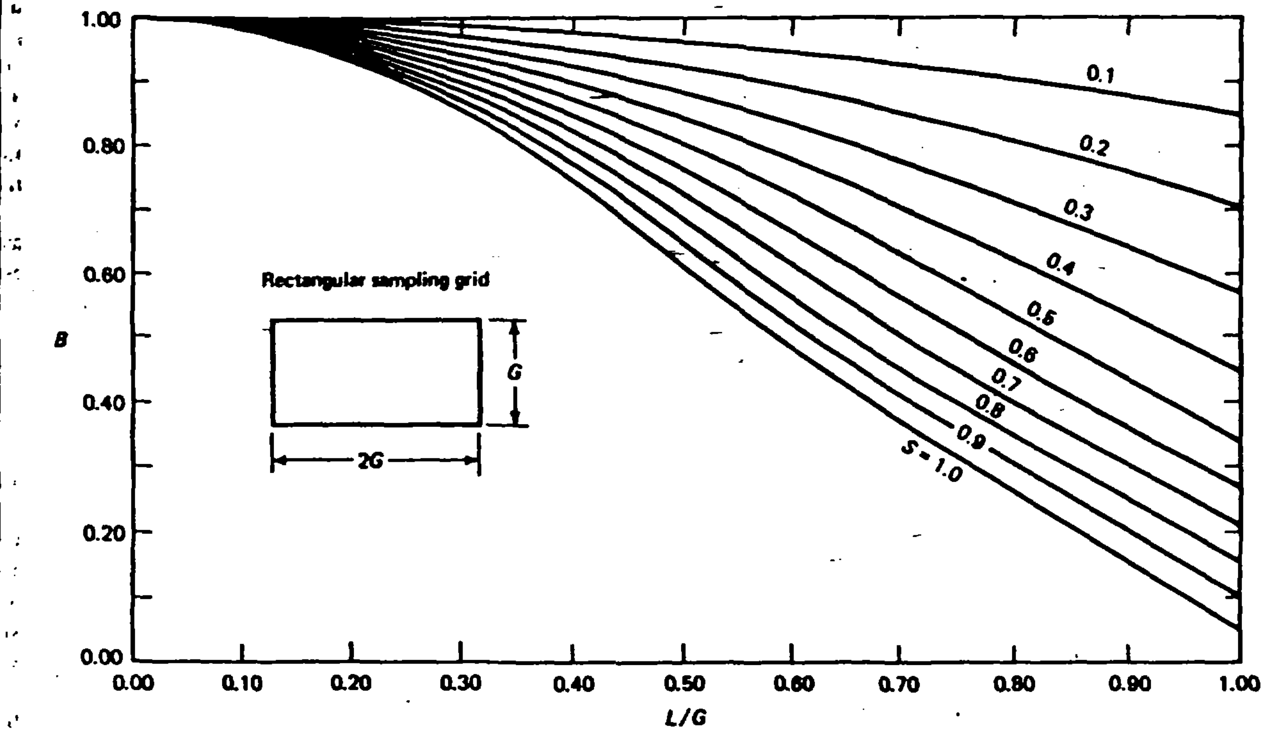
For a burial trench, the limits of contamination are probably fairly well defined: historical records or interviews might indicate the size of the disposal area; plant records might show what volume of waste was generated; and local geologic conditions or construction practices might indicate the depth to which such a trench might have been excavated. Dividing the waste volume by the depth will yield an estimate of the surface area of the trench. Trench geometries can be assumed and the sampling configuration determined for each case. The smallest sampling grid should be selected.

On the other hand, if a chemical has been spilled over a large area, the overall extent of contamination may be known, but the locations of any highly contaminated areas may not be. In this case, one must consider not only the hot-spot dimensions but also the concentration of contaminant that defines a hot spot. A local regulatory agency may have to decide what concentration level and size of hot spot is hazardous; among the factors it will consider are toxicological data, the potential for public exposure, and the potential for waste migration.

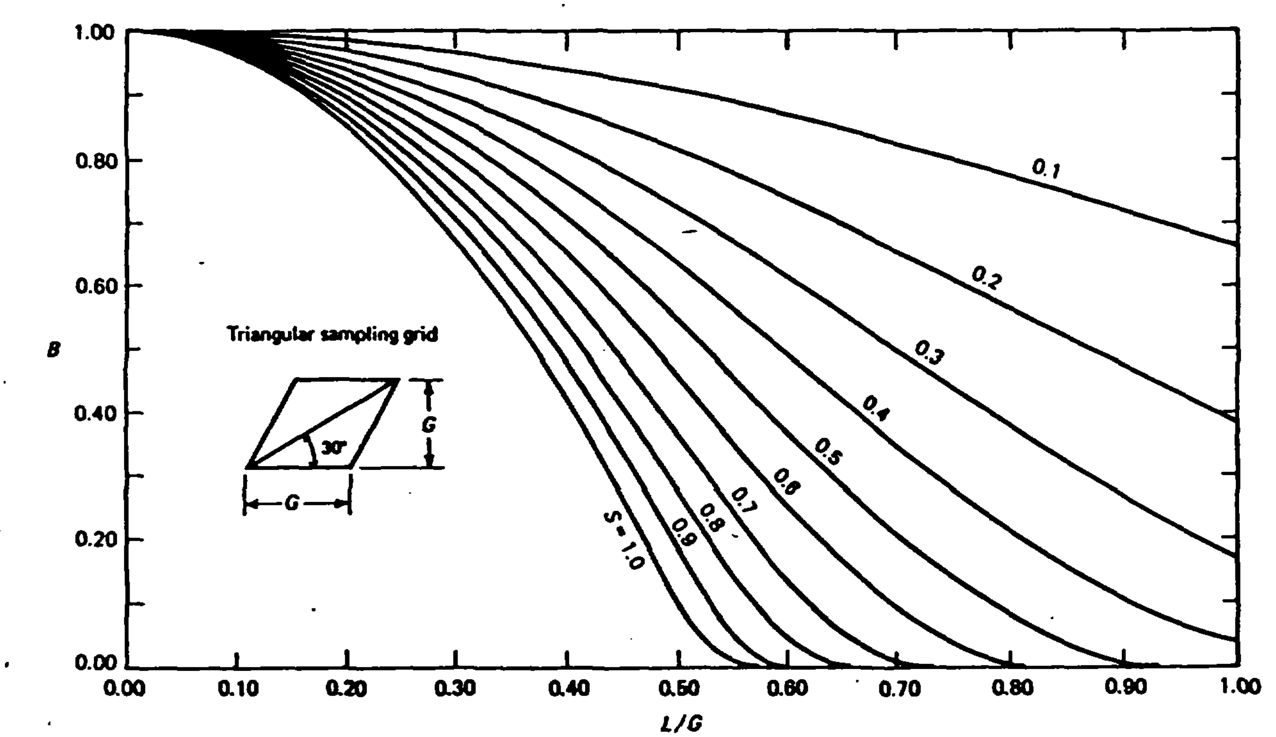
The other variable that must be specified to determine



Public's risk vs. ratio of target's semi-major axis to square-grid spacing for various elliptical target shapes — Fig. 3



Public's risk vs. ratio of target's semi-major axis to rectangular-grid spacing for various elliptical target shapes **Fig. 4**



Public's risk vs. ratio of target's semi-major axis to triangular-grid spacing for various elliptical target shapes **Fig. 5** the grid spacing is the public's risk, B, which can be defined as the acceptable risk or probability of the sampling procedure missing the specified target. In other words, *if one is willing to accept a 10% chance of* missing a hot spot, the risk would be 0.10. This risk is often dependent on the factors listed above. For example, one might want at least a 90% probability of locating a 30-m hot spot, but might only require a 50% chance of locating a 10-m one. Since determining B is subjective, it might be better to leave this judgment to a local regulatory agency.

Finally, a grid configuration (e.g., square, rectangular or triangular) must be chosen, and doing this is somewhat arbitrary. The most conservative approach would be to compare the three patterns and select the one that would result in either (a) detection of the smallest hot spot given a certain acceptable risk, or (b) the highest probability of detecting a hot spot of a given size.

Using the nomographs

Fig. 3-5 can be used in several ways, depending on which parameters are known.

Case 1—If L, S and B have been specified, the grid spacing, G, can be determined. First, draw a horizontal line from B (on the vertical axis) to the curve representing the appropriate target shape, S. From that point, draw a vertical line down to the horizontal axis to find the ratio of the target size to the grid spacing, L/G. Then, since L has been specified, G is simply L divided by the ratio L/G.

For example, suppose you want to determine the square-grid spacing required to have a 90% chance of locating an elliptical hot spot having a long axis of 20 m ($L = 10$ m) and a shape of 0.6. The public's risk would be $B = 1.0 - 0.90 = 0.10$. On Fig. 3, the intersection of $B = 0.10$ and the curve for $S = 0.6$ corresponds to an L/G ratio of 0.75. Thus, $G = 10/0.75 = 13.3$ m.

Case 2—Conversely, if a grid spacing has already been selected, the size of the hot spot (of a given shape) likely to be detected can be determined. Here, B, S and G are the known parameters. L/G is found in the same manner as described above; then, to calculate L, L/G is multiplied by G.

For instance, assume that a rectangular pattern has been chosen and that samples can only be collected every 20 m in one direction and every 40 m in the other. If the target hot spot has a shape of 1.0, and the acceptable public's risk is 0.20, then, from Fig. 4, L/G would be 0.86. Solving for L yields a hot-spot size of $L = 20(0.86) = 17.2$ m. Thus, there would be an 80% chance of locating a circular 17.2-m-radius hot spot, using a rectangular sampling grid with a 20-m × 40-m spacing.

Case 3—A proposed survey plan can be analyzed to determine the probability of detecting a hot spot of a given size and shape, simply by reversing the steps described above. Since L and G are known, calculate L/G. Draw a vertical line from that value on the horizontal axis up to the curve representing the appropriate shape, S. From that point, draw a horizontal line to the B axis to find the public's risk.

As an example, suppose you want to know the probability of locating a hot spot with $L = 10$ m and $S = 0.3$, given that your sampling contractor proposes to use a 10-m triangular-grid pattern. Using Fig. 5, a line drawn from $L/G = 1.0$ to the curve for $S = 0.3$ and then extended to the left yields $B = 0.18$. Thus, there is an 82% chance that the target will be found.

Case 4—But what if sampling with grid spacing G found no hot spots of the size (or larger) and shape of concern, given that p is the *a priori* probability that such a hot spot exists (specified before sampling)? The probability that such a hot spot exists, even though sampling did not find it, is $p_a = Bp/(Bp + 1 - p)$ [2].

For instance, if $L = 10$ m, $B = 0.1$, $S = 1$, and a square grid is to be used, Fig. 3 gives $G = 17.9$ m. If the best pre-sampling guess for p was 0.25, then $p_a = 0.1(0.25) \div [0.1(0.25) + 1 - 0.25] = 0.032$.

Application

A typical application of this procedure might be as follows:

Chemical wastes are known to have been disposed of in an area measuring 100 m × 100 m. From interviews with employees, plant officials have learned that the wastes were buried in a trench roughly 20 m long by 12 m wide, but the exact location of the trench is not known. Soil samples will be collected using a square-grid pattern, and plant officials would like at least a 95% chance of finding the trench.

In this case, the hot spot (i.e., the trench) could be approximated by an ellipse with a shape of $S = 12/20 = 0.6$, and a length of $L = 20/2 = 10$ m. From Fig. 3, L/G is equal to about 0.80. Thus, $G = 10/0.8 = 12.5$ m. Given this grid spacing and the dimensions of the field (100 m × 100 m), a total of 64 samples would have to be collected.

Cynthia Fabian Mascone, Editor

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1. Singer, D. A., "ELIPGRID, A Fortran IV Program for Calculating the Probability of Success in Locating Elliptical Targets with Square, Rectangular, and Hexagonal Grids," *Geocom Bulletin*, Vol. 5, No. 5-6, May-June 1972, pp. 111-126.
2. Gilbert, R. O., "Some Statistical Aspects of Finding Hot Spots and Buried Radioactivity," TRAN-STAT: Statistics for Environmental Studies, No. 19, PNL-SA-10274, Battelle Memorial Institute, Pacific Northwest Laboratory; available from National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161.

The authors

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APPENDIX E

ROCKY MOUNTAIN QUALITY ASSURANCE PLAN

INTRODUCTION

Background

Rocky Mountain Analytical Laboratory provides analytical and consulting services to industry, government, and other private laboratories. Projects in the environmental, energy, forensic, occupational health, and product safety fields are commonly supported. The services RMA provides covers the full range of classical and modern analytical chemistry techniqeus and instrumental analysis.

Nearly all regulatory agencies have requirements or recommendations for quality assurance procedures. The decisions made by the regulators and regulated are too important and costly to be made based on inaccurate or misleading data. Fields such as synfuel development, in which the analytical work is not regulatory based, also cannot tolerate inaccurate or misleading data.

Purpose of the Document

This document describes the RMA Quality Assurance Plan. The plan is designed to define quality assurance goals and methods for attaining these goals. Basic and general policies, objectives, organizational responsibilities, and procedures are given in this document. Standard and specific operational, quality control, and methodology procedures are described in other RMA manuals.

Many times a specific project plan must be developed for a project because of its complexity or uniqueness.

Company Objective

The goal of Rocky Mountain Analytical Laboratory is to provide data that has a defined quality, and which is adequate to meet the client's objective in a reasonable time-frame and at a fair price.

TABLE OF CONTENTS

1.0 QUALITY ASSURANCE POLICY STATEMENT

It is the policy of Rocky Mountain Analytical Laboratory (RMA) that the quality assurance and quality control program is adequate to assure that all data collected are of known and documented quality. The QA requirements apply to all data reported by RMA whether generated internally or by subcontractors.

The President of RMA has the responsibility for assuring that the QA plan is implemented. The senior staff member in each technical area is reponsible for establishing the procedures that will result in quality data. An independent quality assurance staff office has the responsibility for assuring that company QA policy is followed.

The objective of the QA plan is to ensure, assess, and document that all data generated and reported are scientifically valid, legally defensible, and are of known accuracy, precision, representativeness, and comparability.

All data generated by RMA or one of its subcontractors must meet the following criteria:

a. Analytical methods and procedures conform to the requirements of the appropriate regulatory agency, such as EPA, OSHA, FDA, insofar as possible. Where no regulatory method exists, standard methods, such as ASTM, AOAC, AWWA, are followed, insofar as possible. All methods are fully documented and include integral quality control procedures.

b. Standard operating procedures and protocols and quality assurance project plans are developed and implemented before data collection begins.

c. The intended use of the data and the associated acceptance criteria for data quality are defined before a project begins. Methods are selected based on these considerations.

d. All reported data are at a quality level adequate for the intended use of the data. Acceptable and contraindicated uses of the data are stated in each report.

e. When possible, precision, accuracy, representativness, and comparability of reported data is stated.

f. Data processing procedures are documented and quality control criteria established for each measurement or project. All data are reviewed relative to these criteria. Corrective actions are taken and samples re-analyzed when data do not meet the established criteria.

The QA Plan is evaluated at least annually and revised as required.

2.0 QUALITY ASSURANCE MANAGEMENT

2.1 RMA President - The President of the company has responsibility for all laboratory activities, including quality assurance.

2.2 Quality Assurance Officer - The QA office reports directly to the company President. The primary responsibility of the office is to independently audit the adherence of laboratory staff to company QA policy. The responsibility includes the periodic introduction of performance evaluation samples into the analysis of samples for on-going projects, the evaluation of quality control data to assure that established procedures and criteria are being followed, and the recommendation of methods to improve the RMA QA program.

2.3 Section Managers - The senior technical manager in each section is responsible for the technical quality of all data and reports from that section. The responsibilities include: junior staff training and supervision; method development, selection, and documentation; development and documentation of quality control procedures and criteria for data quality; data evaluation and report preparation.

2.4 Technical Staff - Every technical staff member must be knowledgeable about and understand the RMA QA program in order for it to be successful. The staff member who has generated a piece of data, obviously affects the data quality the most. In addition, this person is the most familiar with how the data was generated and is in a critical position to help evaluate the quality of the data.

3.0 PERSONNEL QUALIFICATIONS

3.1 Company Management - The management must have sufficient understand of the technical aspects of the projects and analytical techniques to be able to balance the input of personnel and equipment resources with the expected data quality output.

3.2 Quality Assurance Staff - The responsibility of the quality assurance office is structured so that the primary prerequiste for staff is a good background in statistics, mathematics, and auditing.

3.3 Section Managers - All section managers must have sufficient knowledge and experience, both in their field of technical expertise and in QA, to assure and document the quality of the project data. A project is not initiated until the section manager has documented the analytical approach and supervised the collection of data to validate the ability of the organization to produce quality data.

3.4 Technical Staff - All technical staff must have adequate training before being expected to produce project data. Each staff member goes through a validation process in which the data produced must meet acceptable criteria before the staff member is allowed to independently generate data.

4.0 FACILITIES, EQUIPMENT, CONSUMABLES, AND SERVICES

The requirements for facilities, instrumentation, consumables, and services are determined by the type of analyses made and the objectives of each project. Each section manager is responsible for assuring that the facilities, instrumentation, supplies, and services are adequate to produce data of the desired quality.

The specific laboratory facilities, instrumentation, supplies, and services required for each analysis or project are defined in the appropriate written RMA method. The following general guidelines form the basis for the specifications listed in each RMA method.

4.1 Facilities and Instrumentation - All facilities must be adequate to produce quality data with minimum risk to laboratory staff. The suitability of the facility with respect to size, lighting, ventilation, and environmental conditions is the responsibility of the RMA president and section managers. Safety and health features are very important. No work is undertaken unless it can be performed safely with the available facility equipment. In addition, all personnel exposed to toxic carcinogenic or other hazardous materials are provided the opportunity for health monitoring services on an annual basis.

General utility services and laboratory instrumentation must be present and adequate to produce data of acceptable quality. All instrumentation is evaluated before being placed into service to assure that performance specifications are met.

All instrumentation is inspected routinely and appropriate preventive maintenance performed. Maintenance is performed by qualified personnel, whether RMA staff or contract organizations. All maintenance is documented for each instrument. The maintenance log includes the date and type of service performed.

4.2 Consumables - A general RMA procedure is written covering the quality criteria for reagents, standards, and supplies. Most methods also include specific acceptance criteria. The general criteria is that the consumable correspond to its label specifications and that its quality is consistent with the materials' intended use. Standards are compared with other commerical sources and past standards. Reagents are checked for performance and absence of unwanted contamination. Supplies are evaluated for performance and absence of contamination.

In addition, recertification is performed routinely to characterize changes in concentration, formation of new chemical species, or loss of original chemical species to prevent them from degrading data quality. Where possible, the integrity of the substance is checked prior to each use. A permanent written record is made of all certification procedures and users, including names, dates of certification, and use.

4.3 Services - The reliability and quality of all services (e.g., analytical services, audit services, and instrument maintenance) provided is assessed both prior to and during use, both in terms of personnel and service provided.

5.0 DATA GENERATION

Field, laboratory, and engineering activities all affect data quality. RMA usually only directly affects the laboratory component. However, the field and engineering components are affected as much as possible through written and verbal guidance. Good Laboratory Practices (GLP) are established by Standard Operating Procedures (SOP) and in some cases by QA project plans for unique or complex projects. GLPs and SOPs are developed and implemented so that all data generated and reported are scientifically valid, legally defensible, of known accuracy and precision, representativeness, and comparability.

5.1 Standard Operating Procedures - Many laboratory procedures are the same and common to a wide diversity of projects. These routine methods are written in detail describing who does what, when, where, how, and why in a clear, stepwise manner. Standard operating procedures are prepared for the following activities:

a. Sample collection, preservation, and shipment.
b. Sample custody, receipt, and tracking.
c. Document control.
d. Chemical receipt and storage and analytical reference standards preparation and validation.
e. Instrument calibration, maintenance, and repair.
f. Analytical methodology.
g. Quality control and data analysis.
h. Guidelines for method development and validation.
i. Safety.

The standard operating procedures are defined so that they are:

a. Adequate to establish traceability of standards, instrumentation, samples, and data.

b. Simple, so a user with basic technical education, experience, and training can use them properly.

c. Complete enough so the user/reader can follow the directions in a stepwide manner through the sampling, analysis, and data-handling.

d. Consistent with sound scientific principles.

e. Consistent with current regulatory agency requirements and guidelines, including the "Good Laboratory Practices" documents.

f. Consistent with the instrument manufacturer's specific instruction manuals.

The standard operating procedures provide for documentation sufficiently complete to:

a. Thoroughly document all activities related to the collection and reporting of data to assure the scientific validity of the results.

b. Thoroughly document all activities related to the collection and reporting of data to assure that the results are legally defensible.

Deviation from standard operating procedures are documented and justified. The SOPs are updated as needed.

5.2 <u>QA Project Plans</u> - The activities required to support a complex or unique project may not be adequately defined in the standard operating procedures. Specific written QA project plans are required for these projects. The senior technical manager in the area involved writes up the project plan. The project plan addresses the following topics as necessary:

a. Title page with space for approval signatures.

b. Table of contents.

c. Project description including the intended and contraindicated uses of the data.

d. Project organization, technical approach, and responsibilities.

e. Data quality objectives in terms of precision, accuracy, completeness, representativeness, and comparability.

f. Personnel, facilities, supplies, and equipment required.

g. Sample collection, custody, and logging procedures.

h. Document control procedures.

i. Instrument operation, standardization and maintenance procedures.

j. Analysis and quality control procedures.

k. Data processing, analysis, and validation methods.

l. Performance audits, feedback, and corrective action protocols.

Each QA project plan is reviewed internally and with the client before work is initiated.

6.0 DATA PROCESSING

Data processing encompasses all manipulations performed on raw information to change its form of expression, its location, its quantity, or its dimensionality. This includes data collection, validation, storage, transfer, reduction, and analysis.

6.1 Collection - The Standard Operating Procedures and QA Project Plans address both manually collected and computerized data acquisition systems. The internal checks used to ensure suitable quality in the data collection process are identified. Validation of raw data is also addressed.

6.2 Validation - Data validation is defined as the process whereby data are analyzed and accepted or rejected based on a set of scientifically acceptable criteria. The Standard Operating Procedures and analytical methods describe how a reduced data set is generated, including a clearly defined audit trail that can be retraced datum by datum. The validation process includes many forms of manual and computerized checks using specified criteria. The final step in evaluation of data is performed by a trained professional. This is often the most important step because of the complexity of most projects.

6.3 Data Reduction and Analysis - Data reduction is performed according to standard operating procedures. Data analysis is performed to meet the objectives of each project plan. The procedures used to analyze the data are described in the analytical methods and standard operating procedures.

6.4 Data Storage and Transfer - Data storage involves keeping the data so that they are not degraded or disclosed to unauthorized personnel. At every stage of data processing, the data are "backed-up" on tape or in hard copy. Access to data is restricted to authorized personnel. The facility always remains locked. In addition, highly confidential samples and data are further stored in locked cabinets. Data is transferred by means that are specified by the project client.

7.0 DATA QUALITY ASSESSMENT

The quality of all data generated and processed is assessed for precision, accuracy, representativeness, comparability, and completeness. The evaluation procedures are defined in standard operating procedures and project plans. The following aspects are addressed:

7.1 Precision and Representativeness - Precision and representativeness are assessed by collecting duplicate samples and analyzing duplicate samples. Collection, preparation, and analysis procedures are sometimes evaluated separately depending on the objective of the project.

7.2 Accuracy - Accuracy is evaluated by comparing determined results to true or known values of standard samples. Detection limits are determined on the entire method by analyzing blanks. Calibration of methods and instruments is referenced to traceable standards. Analysis of spike and control standards are also used to evaluate data accuracy.

7.3 Comparability and Completeness - Data comparability is usually assured by the use of standard and official methodologies. Data completeness is accomplished by comparison of the project objectives and required outputs as compared to the final report.

8.0 CORRECTIVE ACTION

The reporting of quality data is dependent upon timely data evaluation followed by corrective actions and then re-analysis. The means of correcting problems is highly dependent on the nature of the problem. Specific methods and standard operating procedures describe many typical corrective techniques. However, many problems require a professional evaluation and a unique solution to solve.

The basis for taking corrective action is established criteria. The on-site analyst and senior staff person, in that order, are required to evaluate the data, determine if a problem exists, devise a solution, and take a corrective action that leads to valid data.

9.0 IMPLEMENTATION

This plan, RMA Standard Operating Procedures, and written analytical methods describes a program that is in full operation.

FIGURE 1. RMA ORGANIZATION